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APRIL, 1836.

Practical and Theoretical Mechanics.

Report of Experiments made by the Committee of the Franklin Institute of Pennsylvania, on the Explosions of Steam-Boilers, at the request of the Treasury Department of the United States.

(*Continued from page* 164.)

VII. To determine by actual experiment whether any permanently elastic fluids are produced within a boiler, when the metal becomes intensely heated.

To make this experiment, the bottom of the boiler was to be intensely heated, water to be injected, and the elastic fluids disengaged, to be collected. The bottom of the boiler being cleaned, heated water was thrown in from the forcing pump, the elastic fluids produced flowed through a flexible tin pipe which was attached to the stop cock *a*, (Plates 1 and 2,) and passed into a tub containing water. At the end which dipped into the water, there was a stop-cock, opening and closing the pipe at pleasure; the cock *a*, was always open. On the first day's trial, a small quantity of water, previously placed in the boiler, was allowed to boil away; the bottom of the boiler was heated to redness, and water injected. The stop-cock being opened under a receiver, in the tub serving as a pneumatic cistern, a gas which issued through the flexible tube was collected, the water condensing the high steam with which the gas was mixed. The smell of this gas was empyreumatic, an opaque white vapour came over with it, which disappeared on standing. Half a pint of the gas was collected for examination. The injection of water being continued, the gas ceased to come over.

This gas was subsequently examined; it was a non-supporter of combustion,

was not combustible, did not render lime water turbid; it was, in short, nitrogen gas, with perhaps a small admixture of oxygen.

These observations were considered as only preliminary to a more extended examination of the subject. The theory which makes the decomposition of water, by heated metal, produce hydrogen, and this gas by its union with oxygen, produce explosion, has been supported by many, and deserved a respectful examination. The difficulty of finding the oxygen for the hydrogen to recombine with, has been ingeniously, though, as we conceive, not successfully, parried. The fact, that though water is decomposed by heated iron, hydrogen gas decomposes heated oxide of iron, has also been plausibly urged and supported by collateral evidence, of a similar nature, drawn from the action of heated copper upon ammonia.

To study the subject in detail, it was necessary to examine the relative effects of hot and cold water; the relation between the quantity of gas produced, and of water injected, at different temperatures of the bottom of the boiler; and to raise the temperature of the metal so high that no objection on that score should exist to the results. Moreover, the oxidated surface was to be removed, and the boiler exposed to the action of the water in as clean a state as the nature of the case admitted. The gas was collected in graduated jars, the water drawn in by the forcing pump was taken from a measure, and the quantities injected noted. The time was also noted between the experiments.

The conclusions to which the committee were brought, render a detailed exhibition of the experiments unnecessary, except so far as such a statement may go to show the degree of care which was used in prosecuting the subject, and thus to give confidence in the results. The experiments of the *first* day in which the gas was collected as already described, were tentative, they served to render the methods of experimenting more precise.

On the *second* day, one of the glass plates in the boiler-head cracked, and the escape of gas with the steam, through the crack, rendered the results as to quantity, inconclusive. The gas was uniformly found to extinguish a candle, and not to burn itself. The mercury in the iron tube into which the thermometer N, Plate 1, dipped, soon boiled; the thermometer had been previously removed. The thermometer in the other tube M, was observed as giving an indication of whether the temperature within was increasing or diminishing.

It was now distinctly seen that the air which furnished the nitrogen gas, before referred to as issuing from the boiler, was not derived from the water injected. The injection of one fluid ounce and a quarter troy (2.25 cubic inches) of water, never gave less than 2.6 cubic inches of gas, and sometimes notwithstanding the leakage, gave 17.28 cubic inches. But water absorbs, according to Saussure, from 5 to 5¼ per cent. of its bulk of atmospheric air, giving for 2.25 cubic inches only .118 of a cubic inch of air, not one-twentieth part of the minimum quantity of gas derived from the boiler by the injection of 2.25 cubic inches of water. On observing closely the cracked glass plate, it was seen, that after a certain period in the production of steam by the water thrown into the boiler, the vapour ceased to issue through the crack, and finally, that a bending inwards of the pieces of glass indicated that the pressure within the boiler was less than that without, and that atmospheric air had access to the interior. As no inflammable gas had as yet been obtained, and as the gas which issued was nitrogen mixed with oxygen, the entrance of air into the boiler was obviously the source of the gas collected.

A new glass plate was substituted, on the *third* day, for the broken one, and a copper plate was screwed upon the opposite opening of the boiler, which

was thus rendered as tight as the nature of the apparatus permitted. The experiments were made at regular intervals, varying in different parts of the series from sixty to ten seconds, and in such a manner, that the bottom of the boiler might be found in nearly the same state, in some of the experiments, with each interval. The interval was counted from the time at which gas ceased to issue in a previous experiment, to the instant of injecting water. The unit of measure of the gas was 1.8 cubic inches. The results were as follows.

Fluid ounces of water injected	Interval in seconds.	Measures of gas collected.	Ounces of water injected.	Interval in seconds.	Measures of gas collected.	Ounces of water injected.	Interval in seconds.	Measures of gas collected.
½	60	10†*	½	30	5	½	10	4
„	30	10†	„	„	9	„	60	10¾
„	„	10¾	„	„	8	„	10	6
„	„	10¾†	„	10	6	„	60	7
„	20	10	„	„	5	¾	10	5
„	„	8	„	30	10¾†	¾	10	4
„	„	6	„	10	10			
„	10	6	„	„	7			
„	„	7	„	„	5			
„	30	5	„	60	6			
„	„	9	„	„	10			
„	„	8	„	20	6			
„	10	6	„	10	4			
„	„	5	„	60	7			

* The numbers marked (†) signify that an unmeasured portion of the gas escaped.

In this series we remark, first, that the mean result for an interval of 60 seconds, is 8.5 measures; for an interval of 30 seconds, 9.1 measures; for 20 seconds, 7.5 measures, and for 10 seconds, 6.9 measures.

If atmospheric air leak into the boiler, the air will enter until the pressure within and without become equal. Hence an increase in the interval between two experiments in which the air should be expelled, would, above a certain point, be attended with no increase in the quantity of gas which would be expelled; the only effect being to consume, more completely, the oxygen of the entering air. Up to this point an increase of interval should be attended by an increase of air which would leak in, and consequently by an increase in the amount subsequently expelled. The mean results given above do, in fact, show an increase in the quantity of gas obtained after an interval of 20 seconds, over that obtained for 10 seconds: of 30 seconds over 20 seconds. They give a slight decrease from the interval of 30 seconds to 60 seconds, which will find its explanation on a further examination of the results.

Second; we observe from the table, that after a number of short intervals, the succeeding long interval never gave as much gas as when the long interval had been repeated; and, vice versa, that after a series of long intervals, the next succeeding short interval gave a higher result than that which followed. The experiments, with an interval of 30 seconds, were not as much interspersed among the short intervals, in the last part of the series, as were those of sixty seconds; the mean of the results for this latter interval is therefore diminished.

No increase in the amount of gas was obtained by increasing the quantity of water injected. The mean of four experiments, when the bottom was at a glowing red heat, and the thermometer seven and three-quarter inches from the bottom, at from 553° to 559° Fah., was 5.75 measures for 1½ ounces of water; from 572° to 580°, by the same thermometer, 10.5 measures for the same quantity of water injected; above the range of the scale of the same thermometer, 12 measures for 1½ ounces, and about the same quantity for 2 ounces. During these experiments, mercury, which was on the top of the boiler, in a clay receptacle, boiled freely. The best evidence is thus given that the bottom of the boiler was not wanting in heat; it was, in fact, at a bright red heat during the last part of the experiments.

The peculiar odour, before remarked, as belonging to the gas expelled from the boiler, still continued, indicating the presence of sediment within the boiler; this could be seen when the metal was glowing. A scale of oxide also appeared on the bottom, which now and then cracked, presenting irregular luminous lines as the boundaries of the scale.

The experiments just detailed were, on a succeeding day, repeated, to ascertain whether the same results would be reproduced. The bottom of the boiler being at a bright red heat, an interval of 60 seconds gave, as the mean of four experiments, 11.5 measures of gas for one ounce of water injected; an interval of 30 seconds gave, as the mean of five experiments with three-fourths of an ounce of water, 13 measures; an interval of 20 seconds gave, as the mean of four experiments with half an ounce of water, 10.6 measures: and again, in a second series, the same interval gave 10.5 measures for the mean of four experiments with five-eighths of an ounce of water. Towards the close, the numbers for 10 seconds of interval were very variable, the mean of six experiments with .65 ounces of water, injected when the boiler was at a cherry red, was 6.3 measures of gas; with a heat which, to all appearance, was the same, the gas collected diminished to 3.5 measures, and averaged 3¾ measures at a bright red heat. For an interval of 5 seconds, with 1¾ ounces of water injected, 4½ measures of gas were obtained. The conclusions to be drawn from these results agree with those already deduced from the previous experiments, which were thus confirmed. The gas collected was carefully transferred, over water, to the laboratories, where it was analysed. One specimen yielded Professor Hare, nitrogen with seven per cent. of oxygen; another, examined by Professor A. D. Bache, gave nitrogen, and 9½ per cent. of oxygen: in each case the results were obtained by exploding a mixture of the gas with hydrogen.

The boiler was now thoroughly cleansed, that the scale of oxide upon the bottom might be removed; in doing this, the hand-hole was necessarily removed, and had to be repacked. Paper was placed between the glass plate at the back end of the boiler and its metallic covering, that the boiler might be tightened. To ascertain the amount and direction of the current setting into, or out of, the boiler at any time, a copper pipe, terminating in a glass tube, was attached to one of the stop-cocks on the head, at the fire end of the boiler, the glass tube dipping into a vessel containing water.

The injection water was, on resuming the experiments, heated over a small furnace, to boiling, in a metallic vessel, from which it was drawn by the pump. When the bottom of the boiler was at a bright red heat, the lowest thermometer had attained a temperature of 570°, and was soon after removed. The quantity of water thrown in at each stroke of the pump, was now by no means so regular as when the action of the pump was not impeded by the formation of steam within it, from the injection water. The results obtained were:—

No. of strokes of pump.	No. of measures of gas collected.	REMARKS.
2	2	Injection water hot.
"	½	Redness not visibly diminished by water injected.
2	3†	Bright red. Experiments made after a rest. Gas puts out candle.
2	3¾	Bright red. Do.
2	1½	Do. Do.
6	3	Do. Gas burned at mouth of jar with a blue flame.
1	¾	
1	½	Gas burns with blue flame.

A combustible gas had appeared for the first time. The injection water was now changed for cold water, and a gas obtained, which burned as before; 11 measures of air and one measure of the gas detonated slightly, also one to 8½ measures of air; neither detonation was sufficiently violent to extinguish the candle held at the mouth of the jar in which the gases were fired.

The gas now came over, not in copious bubbles and during a short time, but slowly and continuously, as if resulting from a constant, but not violent, chemical action. After these results had been obtained, the violent and brief bubbling, when the water was injected, recommenced, and the combustible gas was no more obtained. The change of hot injecting water for cold, and the collection of the combustible gas after the change, showed that the gas was not derived from any effect produced by the increased temperature of the liquid introduced. The other circumstances which had been different from those of former experiments, were the superior cleanliness of the bottom of the boiler, and the repacking of the hand hole with cloth, oil and putty, and of the glass window with paper. Before proceeding to the detail of the experiments, in examination of the source of the combustible gas obtained, it may be well to mention that the glass tube, already spoken of, showed, after the water injected in some of the experiments had evaporated, a current of air, due to a force equivalent to a head of from ½ to 1½ inches of water, from the exterior into the boiler; in one experiment it is noted that the water, in the tube referred to, soon fell, which indicated a leak in some part of the boiler.

On the day following that upon which the experiments just given, were made, nothing conclusive was obtained; no combustible gas appeared, but the heat was hardly as high as on the preceding day. Small disks of wood, thrown into the boiler, gave a combustible gas, which came over just as was noticed in relation to the inflammable gas of the preceding day's experiments. That these inflammable gases, in mixture with the oxygen, remaining in the atmospheric air, within the boiler, produced no explosion, is in accordance with

the well known fact in relation to them; pure hydrogen, in such a mixture, combines with oxygen under the influence of a body heated to redness.

On the following day of experiment, circumstances proved entirely favourable; the bottom of the boiler was heated as intensely as on the former occasion. After much incombustible gas had been obtained, traces of an inflammable one appeared. A strong smell of oil was noticed about the hand hole, at the back end of the boiler; the packings were now white on the exterior. The fire was urged, and the boiler became strongly heated throughout its whole length. The following results are from the journal of the experiments.

Each stroke of the pump threw in 5-8ths of an oz. of water. The gas is that collected by one stroke of the pump.

Appearance of Boiler.	No. of Measures of Gas.	REMARKS.
Bottom bright red,	16	Candle burns feebly in gas.
do.	10½	A piece of paper put against back hand hole is charred.
Very bright,	14	Wood put at back end of boiler (outside) charred. Paper browns on top. Gas puts out candle.
do.	7	Gas puts out candle.
Heat same (about) as first day of finding inflammable gas,	8	
do.	8	
do.	7½	Wood chars at fire end (outside) being the less heated end.
Heat greater,	5	
do.		Gas extinguishes candle and does not burn.
do.		No smell of oil gas. Wood at both ends charring. Paper on top of boiler charring.

No combustible gas was procured in these experiments, though the circumstances were more favourable to the production of hydrogen, by the boiler, than on other occasions. On examining the cloth packing of the hand holes at each end, it was found to have disappeared, except in spots; the putty was white. The boiler was not dirty enough to colour, with oxide of iron, clean water which was introduced.

These results point conclusively to the packing, as the source of the combustible gas obtained. The flame of that gas was that of carburetted hydrogen, and not of pure hydrogen. They further show that even in this intensely heated state of the bottom of the boiler no hydrogen was liberated by the decomposition of the water injected.

In conclusion, it appears from these experiments:

1. That the gas obtained by injecting water upon the bottom of a boiler which was at a bright red heat, was nitrogen gas, with a variable quantity of oxygen: it was, in fact, atmospheric air deprived, by the heated metal, of more or less of its oxygen.

2. That this air was derived, principally, from the current into the boiler when surcharged steam had ceased to be formed, and the boiler was left dry; there will, therefore, be no such quantity in a working boiler, where the air must be supplied from the cold water thrown in.

3. That water in contact with heated iron in a steam boiler, the surface being in its ordinary state, clean, but not bright, is not decomposed by the metal.

VIII. To observe accurately the sort of bursting produced by a gradual increase of pressure within Cylinders of Iron and Copper.

It has been contended by some, that ruptures produced by a gradual increase of pressure within steam boilers do not bear the character of explosions, but that a mere rending takes place, giving escape to the contents. This has been assumed to be especially the case with copper boilers. To make the observation required by the above question, cylinders of iron and copper were prepared, of sufficient size, to make a small thickness of material answer for rending by a pressure which was easily attainable. Two experiments made, one with an iron and another with a copper cylinder, afforded so direct an answer to the query that it was not deemed necessary to carry the experiments further, especially as they were tedious, and not without danger. A further experiment of the same tenor, resulted from a trial of Perkins's assertion in regard to the effect of making an opening in a vessel containing water, and heated to a high temperature.

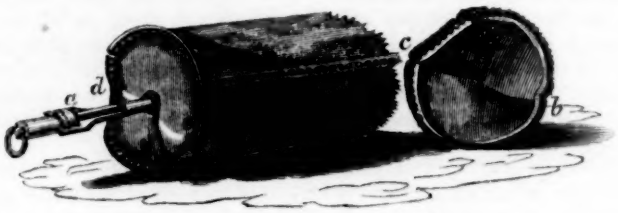
The boilers used were cylindrical, eight and a half inches in diameter, and ten and twelve inches respectively in length, of iron .02 inch thick, and of copper .03 inch thick, having iron heads .05 inch thick, to which the convex surface was fixed by iron rivets, placed nearly touching each other. A single opening in the middle of one of the heads of each boiler was provided to introduce the water, and was furnished with a screw, into which to insert a tube and piston, connected with a small spring weighing machine, which is represented at *a* in the cut on page 224. Upon the cylinder of this machine a ring was placed, which was moveable along the cylinder by a slight pressure: this ring was forced towards the end of the cylinder nearest to the boiler head, as the spring was bent and remaining in its place when the spring relaxed, served to register the maximum pressure to which the piston had been exposed previous to observing it.

The iron boiler was placed in a heavy cylinder of wrought iron, which served as a furnace, the axis of the boiler being nearly horizontal, and that of the furnace cylinder vertical. The boiler, having been half filled with water, was placed upon a fire of charcoal, and when the water boiled, the register machine for the pressure was screwed in.

The place selected for the experiments was in a deserted quarry on the banks of the Pennypack, near Holmesburgh. The high bank served as a protection, by the aid of which the experiments were viewed with little danger. A wire and cord were attached to the head of the boiler, to draw it from the fire when the latter required to be replenished. A leak in the riveting of the iron boiler allowed so much steam to escape that the boiler did not give way on the first trial. As soon as the escape of steam was observed to cease, the boiler was removed from the fire and again half filled with water. The fire was urged, and the boiler settled lower into it, and by once replenishing the fuel, without removing the boiler, an explosion was produced. Part of the committee were engaged in observing the progress of the experiment at this moment. The fire was near the middle line of the boiler, burning not strongly near that line, but very rapidly below the boiler; the steam issued freely through the leak before alluded to, and the whistling sound which it produced, and which had increased gradually in strength as the experiment progressed, seemed constant. The length of time during which the steam had escaped showed the water to be low, and induced the supposition that a second time the object would fail; when an explosion occurred. The explosion tore off one of the heads, *b c*, of the cylinder, projecting the other parts of the boiler in an opposite direction, carrying with them for a portion of the distance, the iron cy-

linder forming the furnace, and scattering the fuel in every direction. The report attending the explosion resembled that from a small mortar (eprouvette) fully charged, the steam mixed with the smoke was not considerable in quantity, and few marks of water were to be seen. The boiler head was thrown fifteen feet, the boiler and spring register about six feet, and the furnace, weighing about forty-five pounds, was overturned and carried four feet. The pressure indicated by the register was eleven and a quarter atmospheres.

In examining the boiler it appeared that the head, *b*, which was thrown off,



had first struck against the iron furnace, which had deflected it outwards; this is shown by the indentation, *b c*, in the figure. This head was forced off all around in the line of rivets which attached the head to the boiler, the metal remaining between the rivets being less than the space occupied by them. The convex surface and the other head were thrown likewise against the furnace, and the head indented at *d e*, overturning the furnace and carrying it four feet, as already stated. The boiler finally struck against the side of the bank of earth. The piston of the weighing machine was somewhat bent in the experiment.

The circumstances of this experiment show that the steam rose quite gradually on account of leaks in the boiler, increasing, probably, more rapidly as the quantity of water diminished, the intensity of the fire meanwhile increasing. That at a certain period the tension within had attained about eleven atmospheres, when the boiler ***exploded violently.***

The accompanying figure will serve to give an accurate idea of the appearance of this boiler after its rupture.

The cylinder of copper, before referred to, was next put in the place of the iron boiler, and the fire again kindled; the general arrangements being as before described. This boiler being longer than the former would not descend so far into the furnace, and an attempt to raise the steam sufficiently high to burst it failed: there was a considerable leak in the junction of the curved surface with one of the ends. When the water was nearly exhausted, the fire having passed its period of greatest heat, the cylinder was removed and water again introduced, filling about three-fourths of its capacity. A new furnace was constructed of stones, allowing the boiler to rest more closely upon the fuel and affording a screen from the wind which was blowing quite strongly. The part of the boiler in which the leak had been observed was turned downwards, but a similar escape was found for the steam in the part now uppermost. The tension of the steam appeared to increase very slowly, and the fire passed its best action without effect; it was renewed, and as the water became lower the tension of the steam increased considerably. As before, nothing remarkable occurred previous to the instant of explosion, and the members of the committee, employed in the experiments, were engaged in observing the boiler at the instant it exploded. A dense cloud of smoke and flame, capped by steam, rose from the pit; the stones and combustibles were

widely scattered, and the boiler was thrown, in a single mass, about fifteen feet from the furnace. The noise attending this explosion was like that from the firing of an eight inch mortar.

The boiler was rent as shown in the accompanying figure, giving way in

an irregular line just above the probable water line on one side of the boiler, but not conforming to it. *d* and *b* were the lowest points in the two heads before the explosion. The sheet of copper was torn from the heads, unrolled and irregularly bent, adhering to the heads for only a short distance near the top of each; and the heads were bent outwards. The thickness of the copper along the line of rupture varies from .025 to .035 of an inch, and the metal appears to have been highly heated at one end of the torn portion. The piston of the spring gauge was bent, the screw which attached it to the boiler broken, and the whole instrument otherwise injured; it appeared that the wire intended to draw the boiler off the furnace had slipped and impeded the action of the piston, so that no register of the amount of force producing this explosion was obtained.*

The circumstances, as before, show that the steam was allowed to rise gradually until the boiler gave way. It is possible that there may be a relation between the space occupied by the water and that in which the steam is formed most favourable to the production of steam, and that when this was attained a rapid rise in elasticity took place; but there were no circumstances observed which would confirm such a view, and if it were correct it would only affect the conclusion as far as the increase of tension might have been rapid from such a cause.

As in the former case the marks of the sediments remained in the boiler, and indicated that the water was about an inch deep when the cylinder exploded. Much more steam was formed, and more water left than in the first experiment.

These experiments, together with the one referred to in a subsequent part of this report, are direct and conclusive; they show that ***all the circumstances attending the most violent explosions may occur without a sudden increase of pressure within a boiler.*** There can be no doubt, however, that if particular

* Assuming the strength of copper at 36,000 lbs. to the square inch, and that it was uninjured by the heating, neglecting also the effect of temperature, the bursting pressure appears by calculation, to have been about sixteen atmospheres. It was, no doubt, less than this.

portions of a boiler are much weaker than other parts, they may give way in time to prevent such a catastrophe.

IX. To repeat Perkins's experiments, and ascertain whether the repulsion stated by him to exist between the particles of intensely heated iron and water be general; and to measure, if possible, the extent of this repulsion, with a view to determine the influence which it may have on safety valves.

The first trials upon this subject were made under atmospheric pressure. An iron bowl, about $\frac{1}{16}$th of an inch thick, and having the bottom perforated with small holes, was heated to redness over a charcoal fire, and water poured into it; the mass of metal being small, was cooled down very rapidly to a temperature below redness, and the repulsion which was at first manifested between the water and iron ceased, and the water flowed rapidly through the apertures. Two thicker bowls were provided, one of wrought iron, $\frac{3}{8}$ths of an inch thick, and the other of cast iron, seven-sixteenths of an inch thick; the bottom of each was perforated with holes, about .04 of an inch in diameter. When placed over a charcoal fire and heated to redness, water poured in so as to fill the bowls, reduced the temperature of the wrought iron one most rapidly, but until the reduction was effected, the results were the same as those for the cast iron bowl. In this latter the water rested upon the bottom without passing through the holes, either as water or as steam; steam formed slowly and escaped from the upper surface, the whole fluid being at a temperature below the boiling point. The openings were distinctly to be seen, and appeared by measurement to have contracted about $\frac{1}{7}$th part of their diameter; but the repulsion was such as to render the escape of the water quite as difficult, and indeed more difficult, than that of mercury at ordinary temperatures. Removing the vessel from the fire, the water remaining in it, as the material cooled below redness, small particles of water came through at intervals; at a lower temperature large drops collected, which finally united into a full stream. Some rude measurements of the quantity of water which came through when the iron was heated in water at different temperatures, showed a striking diminution at the higher temperatures. These results were obviously not produced by the closing of the apertures as the bowl expanded by heat, the openings being distinctly visible at a red heat.

The measurements referred to above were as follows: at 58°, $3\frac{6}{8}$ fluid ounces of water passed through the holes, in the cast iron bowl above referred to, in thirty seconds; the whole quantity of water added, being four ounces.

In another experiment at 60°, $3\frac{3}{4}$ fluid ounces passed. Water at between 58° and 60° being thrown into a bowl previously heated to 82°, $3\frac{1}{4}$ fluid oz. passed through; when heated to 170°, $2\frac{7}{8}$ oz. passed in the same time, and when heated to 660° about $2\frac{1}{16}$ oz.

In another series, the same bowl being heated to redness, four fluid ounces of water thrown in were perfectly repelled for 15 seconds, and at the end of half a minute only $\frac{3}{8}$ths of an ounce had flowed through the openings.

Of a second quantity of four ounces thrown into the bowl thus cooled, $1\frac{5}{32}$ oz. passed in 30 seconds, next $2\frac{1}{4}$ oz. in the same time.

These experiments show that the amount of the force of repulsion between water and heated metal, is measurable even at moderate temperatures, and rapidly increases with the increase of temperature of the metal; the temperature of the water being in each case, of the last set of experiments, nearly the same. They confirm, in this respect, the results of the vaporization of water by metal at different temperatures.

The pressure of the column of water which was supported over the lowest

of these openings at a temperature between 660° and a red heat, or 800°, was less than one inch and a half of water.

The committee now proceed to give an account of an unsuccessful attempt to repeat Perkins's experiment referred to in the query. As it does not seem to bear upon the application of the safety-valve, they did not deem it necessary to encounter the expense of the apparatus necessary to a further trial.

The experiment of Perkins, which is more particularly referred to in the query, is that in which an opening having been made in one of his generators, containing intensely heated water in contact with red hot metal, neither steam nor water escaped, and in which having affixed a pipe and stop-cock to the same vessel, no steam issued through the cock when opened. To repeat this with a view to ascertain, as required in the query, the size of opening to which such a result would apply, three apertures were made, $\frac{1}{16}$th, $\frac{1}{8}$th, and $\frac{1}{4}$th of an inch respectively, in the sides of a wrought iron mercury-bottle; these were closed by conical plugs connected with levers, by which the plugs could be withdrawn from the sides of the bottle. The fulcrums of these levers were attached to the wrought iron cylinder already referred to, within which, its axis coinciding with that of the cylinder, the cylindric bottle was placed. An earthen-ware furnace was placed below the bottle and surrounding cylinder, the latter resting upon wrought iron bars supported by the edges of the furnace, and the former supported by a stone placed upon the grate of the furnace. Besides affording a support for the levers, the wrought iron cylinder was introduced to protect the experimenters against injury, should the bottle explode in the trials to be made with it. This apparatus having been placed in a quarry pit, adjacent to that in which the cylindric boilers were burst, water was poured into the bottle so as to fill it, the screw plug was next passed into the neck and forced home by lateral blows from a hammer: a fire was now made in the furnace, and the fuel heaped up so as to fill the entire space between the mercury bottle and wrought iron cylinder, and to be about five inches deep above the stopper of the former. A string was attached to the lever connected with the smallest plug, and carried up the bank. The fire soon burned briskly, and it was perceived that a small quantity of steam mingled with the feeble smoke and heated air which rose above the apparatus. About twenty minutes after the beginning of the experiments, the leak appearing to increase, an incautious attempt was made to stop it, but without success; at this time the bottle was seen to be at a dull red heat. It was thought that but little water had been able to escape in steam through the very minute opening which the imperfect thread of the screw gave, and it was intended to withdraw one of the plugs, when a few minutes should have elapsed to give time for the bottle to be heated to complete redness. Meanwhile a most violent explosion occurred, the body of the bottle rose in the air, the iron cylinder which served to increase the height of the furnace, was thrown from its place, the earthen furnace blown to pieces, and the fire scattered far and wide through the woods. After extinguishing the fire, it was found that the iron cylinder, weighing, with the apparatus connected with it, 61$\frac{3}{4}$ lbs, had been thrown four feet from its bed: the plugs which passed into the bottle had been broken short off at the exterior of the bottle; the bottom had been forced into the ground, which was ploughed up by the fragments of the furnace, and completely wet for a considerable distance around; one of the iron bars supporting the cylinder was thrown to a distance of thirty feet, and sunk three inches into the ground. The body of the bottle was found thirty yards from its position before the explosion, having penetrated two feet into the ground. The noise of the explosion resembled that of a twelve pounder fully charged.

This experiment proved, first, that steam, from intensely heated water, was able to penetrate an exceedingly small opening. Although it proved nothing in regard to an aperture made in a vessel containing water only, it showed an effect produced when there was very little steam in the vessel. It verified the deduction, from theory, that but a small part of water, highly heated, can expand into steam, if suddenly relieved from pressure. It showed that great danger must be incurred in attempts to heat water very highly, even in vessels where it has but little room to expand itself, contrary to the opinions entertained by many: and that an attempt to repeat the experiment of Perkins, unless with an apparatus capable of sustaining the most intense pressures, must be attended with great danger.

The wrought iron bottom of this bottle was welded upon the convex surface, and a portion of the welding appeared defective, but generally it was sound. The bottom having been torn from the convex surface, or from lateral portions, the strain was a transverse one, and, from calculation, could not have been less than ten atmospheres.

X. To ascertain whether cases may really occur when the safety valve, loaded with a certain weight, remains stationary, while the confined steam acquires a higher elastic force, than that which from calculation would appear necessary to raise the valve.

CONSTRUCTION AND GRADUATION OF THE SAFETY VALVES.

Of these there were two used at different times, the same in construction. They were disk valves, as shown in figure B, Plate 4, the valve seat was .515 inches in diameter, in each, and the diameters of the valves .70 of an inch. The stem *r*, to which the disk *p*, was attached, passed through the half collars *o* and *o'* which served as guides. On the point terminating the upper end of the stem, pressed the lever *l*, *m*, for receiving the weights. The fulcrum of the lever was a knife edge, resting in a curved opening in the upright *e*, which was screwed into the boiler. (See also K, Plate 1.) The apparatus was graduated by trial, in order that the friction might be duly estimated. The valve, lever, &c., being in place, a delicate balance beam *f f*, graduated to inches and tenths, on each side of the edge *g*, which was its axis, was so placed, fig. B, that one of the divisions was vertically above a small hole made in the valve stem; to this division a cord *h h'* passing through the hole, was attached. A scale pan was hung to a division *k*, of the opposite arm of the balance, and the string and pan made to balance by weights on the arm *f h*. The string being now stretched by a weight rather greater than the probable amount which it would have to bear in the graduation of the valve, the beam was made horizontal. Weights were then placed in the scale pan, until the weight of the lever, the stem and disk, and the friction, being overcome, the valve rose from its seat. This rise was indicated at the end *l*, of the valve lever, by an upright placed there for the purpose. Next a convenient weight was placed in the pan, and the point ascertained on the arm of the lever at which a small weight, assumed, balanced it. Thus several points were determined. In graduating the first safety valve *gh*, was 4.4 inches and *gk* 11 inches, so that the weight raised at *h* was two and a half that applied at *k*. The weight of the lever &c., balanced 24 oz. troy at *k*, or $24 \times 2\frac{1}{2} = 60$ oz.$=5$ lbs. troy at *h*. This weight rested on an effective surface of .515 inches in diameter, or .232 sq. ins. in area. It was equivalent, therefore to 24.04 lbs. troy to the square inch, or to 19.78 lbs. avoirdupois; that is to a pressure of 1.35 atmospheres of 14.68 lbs. corresponding to 30 inches of mercury.

A weight of 6 oz. being at *d*, near the end of the lever *l m*, was balanced by 56 oz. at *k* on the arm of the balance. To determine from this the ratio of *d m* to *n m*, we have $\frac{56\times 2\frac{1}{2}-60}{6}=\frac{80}{6}=13\frac{1}{3}$, which coincided nearly with the ratio given by measurement, being a little in excess.

At the mark *d*, 6 oz. together with the weight of the lever, &c., and friction, produced a pressure of 3.14 atmospheres, and the weight used in the experiments, 9.369 oz. troy, produced a pressure of 3.27 atmospheres, exclusive of atmospheric pressure.

At the mark *c*, called in the experiments the *third* mark, 9 oz. balanced 56 at *k*, and the weight 9.369 oz. together with that of the lever, &c., produced a pressure of 2.63 atmospheres.

At the mark *b*, the *second mark*, 12 oz. were required to balance 56 at *k*; the pressure produced by 9.369 oz. &c., was therefore, 2.31 atmospheres. At *a*, the first mark, 15 oz. balanced 56 at *k*, and the pressure from 9.369 oz. &c., was 2.12 atmospheres.

The experiments with these valves, will show why the committee are so particular in giving the data upon which the graduation was founded. The details in relation to the second valve were as follows.

The string from the valve stem was attached to the mark five, on the balance beam, and the scale to the mark ten on the opposite arm; when $29\frac{1}{2}$ oz. troy at ten, balanced the weight of the lever &c., at five. This weight was therefore 59 oz. troy or 4.04 lbs. avoirdupois: pressing upon a surface of .515 inches in diameter, or .208 sq. inches in area, it was equivalent to 19.44 lbs. to the square inch, or to 1.32 atmospheres of 14.68 lbs. At the last mark, near the end of the lever, a weight of $2\frac{3}{4}$ oz. balanced 49 oz. at the mark ten on the beam of the balance; the weight 3.76 oz. which was used in the experiments together with the weight of the lever, &c., produced therefore a pressure of 2.52 atmospheres.

At the mark next to the end, called in the experiments the second mark, the same weight together with the lever, &c., produced a pressure of 2.10 atmospheres.

Weights of 2.64 oz. and of 5.28 oz. were also prepared to be attached to the mark near the end, the weight of 3.76 oz. being prepared with hooks to adapt it to this purpose. The smaller weights produced an additional pressure of .84 of an atmosphere, and the larger of 1.68 atmospheres.

On the Performance of the Safety Valves.

The committee, with a view to test the performance of the safety valve, selected the form calculated, in their opinion, to be most serviceable in practice, a disk valve. One of these valves was attached to the boiler. This was in action in the different experiments, and was tested by comparing with the temperature of the water within the boiler and with the steam gauge, when this latter was in use; the results were rendered more valuable from the fact that one of the valves having been injured in the experiments on highly heated steam, a second one had to be put in its place and to be graduated anew. The pains bestowed in this graduation enabled the committee, not only to compare the pressure at which the valve opened when similarly weighted in different experiments, but to compare the pressure given by calculation from the area of the valve, &c. with the actual pressure at which the valve allowed a free passage to the steam. Any adhesion of an unusual character could not have escaped detection. The valves were kept in good working order, but no unusual pains

were bestowed upon them, and the experiments ranged through more than two years of interval, irregularly continued. They therefore give quite as severe, if not a more severe, trial, than in a working apparatus. The following tables contain the results of the experiments and the comparisons, necessary to give an entire view of the subject.

The first column of the first table gives the observed temperatures of the steam, the pressure of which raised the safety valve, weighted as expressed in the third column; the pressures corresponding to these temperatures are given in the second column. An abstract of the first table is given in the second; it contains the mean, the highest and lowest observed pressures, and the range of pressure. The pressure at which the valve should have opened, according to calculation, and the ratio of the calculated pressure to the mean is also furnished by the last two columns of the same table.

TABLE FIRST.

Observed Temperature.	Corresponding Pressure.	Situation of Weight.	Observed Temperature.	Corresponding Pressure.	Situation of Weight.
Fah.°	Atmospheres.		Fah.°	Atmospheres.	
255¼	2.1	Valve without weight, except that of lever, &c.	281½	3.4	Weight at second mark.
"	"		279½	3.2	
260¼	2.3		283½	3.5	
257¼	2.2		286½	3.7	
253¼	2.1		281½	3.4	
"	"		277½	3.1	
251¼	2.0		279½	3.2	
255¼	2.1				
271½	2.8	Weight at first mark.	284½	3.5	Weight at third mark.
272½	2.8		287½	3.7	
269½	2.7		291½	4.0	
277½	3.1		283½	3.5	
272½	2.8		285½	3.6	
276½	3.1		285½	3.6	
272½	2.8		291½	4.0	At last mark.
277½	3.1		292½	4.1	
	2.8		297½	4.5	
			293½	4.2	

TABLE SECOND.

Weight.	Mean pressure.	Highest pressure.	Lowest pressure.	Range.	Calculated pressure.	Ratio of calculated to observed.
No additional weight	2.12	2.3	2.0	0.3	2.35	1.11
First mark	2.90	3.1	2.7	0.4	3.12	1.07
Second mark	3.36	3.7	3.1	0.6	3.31	0.98
Third mark	3.65	4.0	3.5	0.5	3.63	0.99
Last mark	4.2	4.5	4.0	0.5	4.27	1.02

The performance of this valve is shown by the table to have been so far satisfactory that the greatest range of pressure between the highest and lowest observations, at any position of the weight, is .6 of an atmosphere. While, therefore, no accurate investigation of the elasticity of steam could result from the use of such a valve, it is found to answer, so far as these results can show, the requirements of practice. In regard to the ratios of the average observed pressures to the calculated pressures, they range from .98 to 1.11, and at a mean the ratio is 1 to 1.034, a ratio which would produce, at higher pressures, marked differences between the calculated and observed pressures.

In a paper by M. Garnier, in the Annales des Mines,* vol. 8, the results of his comparisons of safety-valves, having a considerable projection over their valve seat, with others having a small projection, are given, and are very worthy of attention. He found that a valve, the disk of which projected upon the valve seat beyond the opening of the seat .4 of an inch, opened at a pressure within the boiler, of only two-thirds of that shown by a mercury gauge, and that the distance to which the weight upon the lever of the valve required to be placed from the fulcrum, in another case, for a pressure of four atmospheres, was that corresponding to five atmospheres, if the pressure of the air on the upper part of the valve were estimated. With a disk projecting but .02 of an inch the ratio of the calculated pressure to the observed was 1.06 to 1.

The experiments above quoted, with a disk projecting .1 of an inch, give a less ratio than is indicated by M. Garnier, and show besides that the phenomena are not constant, the individual experiments varying more from each other than the mean varies from the calculated result. The fact developed by M. Garnier is attributed by him to a want of perfect contact between the disk and its seat, and the variations observed by the committee go to strengthen this opinion. Different positions of the disk, different states of its surface, and the interposition of small particles of dirt will satisfactorily account for the want of uniformity in the pressure at which the valve opened when all circumstances were *apparently* the same. Further evidence on this head will be gathered from the results furnished by the second safety-valve. This it will be recollected, was of the same form and dimensions with the first, and similarly graduated. In the following table the observed temperatures and pressures are given, at which the valve, circumstanced as stated in the column headed remarks, opened. The mean pressure, the highest and lowest pressures, and range, are given in the next four columns. The calculated pressure, and the ratio of the mean pressure to the calculated, are in the next two columns.

* Second series.

TABLE THIRD.

Observed temp.	Corresponding pres.	Mean pressure.	Highest pressure.	Lowest pressure.	Range.	Calculated pressure.	Ratio of calculated to mean pressure.	REMARKS.
Fah°	Atmos.	Atmos.	Atmos.	Atmos	Atmos.	Atmos.	Atmos.	
257½	2.2							Up. No weight.
259¼	2.3	2.25	2.3	2.2	0.1	2.32	1.03	
271½	2.8							Leaks badly. One weight at 2d mark.
271½	2.8							
270½	2.7	2.77	2.8	2.7	0.1			
275½	3.0					3.10	1.03	Valve up.
277½	3.1							Not fully up.
,,	,,							
,,	,,							Weight at end.
,,	,,	3.1	3.1	3.1	0.0			
279½	3.2					3.52	1.09	Valve up.
286½	3.7					4.36	1.10	One additional weight.
296½	4.4							Leaks freely. Two additional weights.
299½	4.6	4.5	4.6	4.4		5.20		Leaks freely.
305½	5.1							Leaks freely. Three additional weights.
307½	5.3							Up.
308½	5.4	5.27	5.4	5.3	0.1	6.04	1.15	Up.
313¾	5.9					6.88		Leaks. Four additional weights.
317¾	6.3							Leaks freely. Five additional weights.
319¾	6.5	6.5	6.5	6.5		7.72	1.19	Up.
319¾	6.5							Leaks freely. Marked 4 wts. but was probably 5.
327¾	7.3							Leaks. Six additional wts.
333¾	7.9	7.6	7.9	7.3		8.56	1.13	Up.
329¾	7.5							Leaks.
338¼	8.3							Leaks. Six additional wts. and four oz. troy.
344¾	9.0					9.85		
351½	9.8					11.12		Leaks. Six additional wts. + eight oz. troy.

The weights used in the experiments were verified after their conclusion, and found to be accurate. The ratios of the calculated pressure to the observed increase, and afterwards decrease, showing that the results are not attributable to inaccuracy in the unit of weight which was successively applied. They are not explicable by a defect in measuring the valve seat, as is shown by the nearer coincidences at the lower pressures, when the ratios are much nearer to unity than in the higher.

This valve was fitted, by grinding, twice during the experiments, but that the contact with the seat was not perfect, is shown by the number of times at which leaking is noticed before the rise of the valve; these leaks at the high pressures became very sensible, and increased rapidly, from the instant of their first appearing, to that at which the valve opened.

The mean ratio of the calculated to the observed pressure is 1.10 to 1, but taking for comparison with the first valve, the same range of pressures as was calculated for the first, the ratio is as 1.04 to 1, differing but little from the ratio obtained for the first valve.

This defect in the safety-valve, which affects its use as a means of judging of pressure in proving boilers, is increased as the pressure increases, and may cause an inadequate proof by the forcing pump, or the hydraulic press. No adhesion of an undue kind is shown, by these experiments, to have taken place with the second valve, the difference of pressure of opening and of undue leakage, under similar circumstances, being moderate. The experiments, it should be remembered, apply only to disk valves, and not to those of a conical form.

XI. To ascertain, by direct experiment, the effect of deposits in boilers.

The committee have been fortunate on this head in obtaining the account of the results, on a large scale, furnished by the deposits in the boilers of boats on our western waters; to these they refer, as showing,—

1. That deposits, consisting of sedimentary matter, carbonate of lime, and other salts, collect in particular parts of boilers, and, preventing the communication of heat to the water, are baked hard, becoming "as hard as brick," when the water is low.*

2. That these collections of mud, &c. may, by causing the undue heating of the bottom of a boiler, produce exfoliations of oxide, which gradually reduce the thickness of the metal; or they may allow the temperature of the metal to be raised so high, that it swells out by the ordinary pressure of the steam, and finally bursts. Thus leading, gradually or suddenly, to the weakening the boiler, and to the discharge of its contents.†

The committee have also examined cases of similar deposits in iron boilers, using spring (hard) water. They consisted chiefly of the carbonates of lime and iron, mixed with oxide of iron, containing, besides, the earthy salts from the water. Unless removed at short intervals, they form in the ordinary use of the boilers, and without undue heating, exceedingly hard crusts upon the bottom of the boilers, requiring the aid of the chisel for their removal. Retarding the passage of heat into the boiler, they lead to a great waste of fuel; and exposing the bottom to be unduly heated, they destroy the boiler gradually, by wear, if not suddenly, by explosion.

The nature of these deposits, and the rapidity of deposition, varies, of course, with the kind of water which is used.

[TO BE CONTINUED.]

* Explosion of boiler of steamboat Caledonia, W. Littlefield, p. 310, vol. viii., Jour. Frank. Inst. Anonymous, p. 310, ib. Matthew Robison, p. 311, ib. E. W. Benton, p. 314, ib. Also, L. Hebert; p. 379, ib. Thos. W. Bakewell, p. 386, ib. Thos. J. Halderman, p. 28, vol. ix.

† Col. S. H. Long, pp. 244–5, vol. viii. Prof. Johnson, at monthly meeting of Institute.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On Calcareous Cements. By James Frost, Civil Engineer.

No. III.*

The affinities of lime for the following substances have been classed by chemists, and seem to have been neglected by them as of little importance, or interest; this has probably arisen from their feeble action at low temperatures, and from chemists not being aware of the value of the investigation. As the temperature increases, the affinity of lime increases for all the substances named, becoming at length very intense. Under atmospheric pressure only, at a bright red, or nearly white heat, in the dark, water and carbonic acid separate from lime without decomposition; under increased pressure, they remain in combination, the carbonate of lime forming into a solid, resembling marble. As the temperature increases, the other substances combine with the lime, and undergo partial decomposition, losing oxygen, which is taken by the lime, and retained by it at common temperatures. This fact, and some other curious laws, have been hitherto unregarded, yet will be found of great importance to the right understanding of the subject we have in hand.

The affinities of lime are regular and constant, as must be expected by all who understand chemistry; they are in the following order.

For Protoxide of Silicium.
For " of Manganese.
For " of Iron.
For Carbonic Acid, or Deutoxide of Carbon.
For Silex, or Peroxide of Silicium.
For Alumine.
For Water.

When we examine the lowest of these affinities, that of water, we shall find it of surprising energy; yet, great as it is, and greater as the preceding ones must necessarily be, as they all displace it, these immense forces are singularly limited by some curious laws, which I shall hereafter endeavour to develope, and also to show, in detail, the peculiar action of magnesia, soda, potassa, hydrogen, sulphuretted hydrogen, carbon, &c., which, in many cases, exerting peculiar and important influences, will, of necessity, require considerable detail. Indeed, when it is considered how many elements are included in these combinations, the necessity of detail will be apparent, to render them easily understood, and extensively useful.

When pure lime is moistened with pure water, twenty-eight parts of lime enter into chemical combination with nine parts of water, and form what is termed hydrate of lime. Any superfluous water may be readily expelled from the hydrate, by exposing it to a heat a little above that of boiling water; but the nine parts of water remain fixed at a red heat, and require a heat white in the dark for their expulsion. When the substances are pure, and in sufficient quantity, they become instantly red hot on admixture; a fact well known by the frequent accidental firing of combustible matter in this way. That this combination is permanent at a red heat, may be easily proved by trial, and that it requires a more intense heat for their separation, is evident from the following experiment. 100 grains of hydrate were enclosed in a small platina crucible, to which a cover was luted, having only

* No. 2 was published in the December number of this Journal, vol. xvi., p. 377.

a small tubular aperture in the centre, and being placed in a reverberatory furnace, at a white heat, became equally hot in five seconds; after the lapse of a minute, a cold iron bar was held, for a few seconds, over the aperture of the crucible, and on withdrawing the bar, a drop of condensed water was appended to it; at intervals of a minute, other bars exhibited the same appearance for nearly a quarter of an hour.

The great heat developed in slacking lime, has been hitherto attributed to the latent heat of the water being set at liberty on its assuming a solid form in the hydrate. Now, the heat that ice absorbs in becoming fluid, is 140°, but the red heat of the water in the hydrate is at least 700°
and as the lime is also heated to the same degree, and as the specific heat of lime, compared to that of water, is as .2199 to 1, if we multiply the latent heat of the former by $3\frac{1}{2}$, we shall find the heat of the lime, 467

1167

Deduct the latent heat of water, 140

Remaining unaccounted for, 1027

Being more than seven times the latent heat of water, and which we must leave unaccounted for at present.*

That water is not decomposed in combining with lime, is proved by heating one hundred grains of hydrate in a platina retort, connected with an air-tight condenser, expelling the water from the hydrate, and, when cool, returning the same water on the same lime, several times in succession; no extrication of hydrogen, or sign of decomposition, will occur. As the water held by lime at a red heat, would, if not so held, form steam of immense elasticity, it follows that the cohesive force of lime and water is a still greater force. This expansive force of red hot steam has been differently stated by Rumford, and by Perkins; the lowest statement of the former is 50,000 atmospheres to the superficial inch, more than twelve times the cohesive force of bar iron. What a wonderful exhibition of the power of chemical attraction!

The same compound is formed when lime is exposed for a length of time to the air, from which it certainly, though slowly, absorbs the vapour that may be present in it, and, as we shall hereafter see, with the same proportionate extrication of heat, although, being so slowly extricated, it has hitherto escaped observation by our senses, or by our instruments. Lime, thus air-slaked, as it is termed, also absorbs carbonic acid, and is thus injured, in some degree, for good mortars, and this fact is pretty well appreciated. But its absorption of oxygen seems to have been little regarded, although it is the great source of its use for medical purposes; it is a fact, however, that lime absorbs in slacking, and subsequently as a hydrate, a considerable quantity of oxygen, and hence its use in disinfecting; for, by absorbing oxygen, it liberates nitrogen, which, combining with putrid miasmata, renders it innoxious, or neutral. and, if carefully used, is probably as useful an article as the more expensive, and less well known substances, used for that purpose; but all these absorptions, however useful for particular purposes, are injurious, where good mortar is the object required.

These absorptions of gas are visible by slacking some lime in a cup float-

* Our correspondent here assumes that water, in combining with lime to form a solid, is in the same condition as when frozen; a conclusion which seems untenable.
Com. Pub.

ing on water, and covered with an inverted glass jar, furnished with an opening, and a stop cock, to equalize the internal and external pressure of the air; on closing the cock, the water will be found to ascend in a jar containing atmospheric air, or oxygen gas, and to be stationary in a jar filled with hydrogen. As we shall pursue this investigation with more advantage in a similar examination of cements, we will now proceed to see how easily this intense action between water and lime may be modified, delayed, or suspended, and to show that the art of doing so was known at a very remote period—has been long lost or abandoned—perhaps, on the use of gypsum, being discovered; and how the art may, if revived, be prosecuted with more advantage, or be superseded by improved modes.

As it is necessary, in all admixtures of two or more solid substances, for the purpose of forming any new chemical compound, that their respective particles be previously reduced to an impalpable or indiscernible state, we shall, in future, always consider this as having been effected.

If 100 grains of chalk-lime be mixed with 200 grains each of the substances named in the following table, be tempered with water to the consistence of mortar, and be placed on a plate of glass, they will exhibit the appearance indicated in the table, previous to slacking; and if the quantity of many of the substances is further increased, the lime will not slack at all in dry situations; but, however the other substances may be increased in quantity, or the lime be varied in quality,—however near they may be thus made to approach in appearance to real cements, they will always be found false cements, by immersion in water, as, either on setting, or at considerable and uncertain times thereafter, they fall in pieces, and are likely wholly to disintegrate.

The second column indicates the time occupied in setting to resist a moderate impression of the finger, and the temperature of compound; the third and fourth columns, the times occupied in attaining sufficient hardness to receive a visible mark from a black lead pencil, and of a leaden point; the fifth, the time occupied in slacking, or falling to pieces, which they did, as it were, inside, while hardening externally; indeed, some attained sufficient hardness to receive a distinct mark from a brass point, while becoming rotten internally.

Substances.	Set in	Black Lead.	Lead.	Slacked.
Cast-iron,	1 minute, hot			15 minutes.
Wrought-iron,	5 minutes, hot	5 minutes		6 minutes.
Emery,	4 minutes, hot		2½ hours	7 minutes.
Glass,	10 minutes, warm	15 minutes	4 hours	3 days
Copper slag,	12 minutes, warm	20 minutes	20 hours	9 days
Deutoxide lead,	9 hours, cool	12 hours		24 hours
Peroxide iron,	35 minutes, tepid	40 minutes	3 days	50 minutes
" manganese,	50 minutes, tepid	105 minutes	75 mins. tepid	
" tin,	30 minutes, tepid	40 mins. tepid	3 days	10 days
Silicious sand,	2 minutes, hot	3 minutes	14 hours	
Calcined pure alumina,	3 minutes, warm	5 minutes		
Calcined magnesia,	Never remade at 2 days	4 days	10 days	
White marble,	8 minutes, warm	12 minutes	3 hours	4 days
Chalk,	15 minutes, warm	30 mins. hot		65 minutes
White marble, 300,	30 minutes, cool	1½ hours hot	6 days	Permanent
Chalk, 300,	25 minutes, cool	40 mins. tepid	4 days	Permanent

The ancients were, doubtless, in the habit of using cements like the last

two. A friend, Mr. Bignell, brought me, three years since, a fragment of an enriched ceiling from Pompeii, which he saw in a state of great preservation; on analysis, I found it a nearly pure carbonate of lime, and, while sound, as hard as alabaster; perfectly free from those minute cracks always found in hydrate compounds of lime, formed from pure carbonates.

I have entered rather fully on this subject, not only to illustrate an intricate branch of science, but to give a warning against the use of certain mixtures under the impression that they are useful cements; these, we shall find, may be abundantly procured from many sources hitherto unknown, certain in their action, and cheap in their formation. Before I abandoned the investigations undertaken for finding some useful compound, similar to the last, I tried the compounds of lime with charcoal, coke, sulphur, various metallic oxides, stones, raw and calcined clay, mixtures of alcohol, acetic acid, sugar, treacle, and oils; all of which have the property of delaying, or suspending, the chemical combination of lime and of water, but none led to any useful results.

We will now endeavour to see the real nature of water mortars, or mixtures of pure limes with various substances with which they harden under water, with more or less rapidity; when withdrawn from water, they sometimes continue to harden, sometimes cease their hardening, and sometimes, as it is said, unharden; we will not only endeavour to show how this arises, but show, also, how any one may easily understand these facts, and compare the action of any substance hitherto untried, with those that have been long and well known.

When pure lime is immersed in pure water, it is readily dissolved, provided no more lime is introduced than will saturate the water; and if, in any saturated solution of lime, any lime remains undissolved, and any of the lime in solution is withdrawn by the chemical action of any substance introduced into the solution, the water immediately takes up another portion of the undissolved lime, and always continues in a saturated state. The solution, when exposed to the atmosphere, quickly becomes covered with a crust of carbonate of lime, which defends the solution from farther admixture of carbonic acid; and thus the actions about to be described, take place by virtue of chemical affinities between the lime and water, and other substances, without combination with, or any reference to, carbonic acid, which we shall hereafter find to have peculiar and independent affinities; should any doubt remain on this subject, the experiments may be repeated, with the same results, in air-tight glass jars.

It has long been known that tarras, which is principally a silicious substance, and puzzolano, which differs from tarras, principally, by containing a little more oxide of iron, will, each of them, when reduced to an impalpable state, and well mixed with an equal weight, or more or less, of pure hydrate of lime, and tempered with water to the consistence of mortar, and placed under water, gradually concrete, harden, and become like stone; that, if withdrawn from the water, they almost, or altogether, cease from hardening, and, if returned to the water again, continue to harden to a great degree. It is not so well known, but is equally true, that they may, by merely beating them up, or turning and well chafing up with a shovel, at frequent intervals of a few days, be kept under water, or in moist situations, for a great length of time, without hardening, and without any injury whatever to their subsequent hardening when replaced under water, and suffered to repose; for, though these substances harden greatly in time, say a year, yet the hardness they acquire is almost imperceptible,

say in ten or twelve days; and frequent and thorough stirring of them always restores their original plasticity.

It is also well known that hydrate of pure lime, tempered with water to the consistence of mortar, with any quantity of silicious sand, and placed under water, will never harden, but, on the contrary, if placed in a current of water, the lime will be wholly dissolved, and carried away; but it is also equally true, that if the silicious sand is reduced to an impalpable state, previous to, or after, admixture with the hydrate, the mixture will harden gradually under water; and it is also equally true, that a similarly formed mixture of hydrate, and of calcined pure alumina, will harden under water, and that neither of these substances harden so readily, or so much, under water, as tarras, or puzzolano, which are both principally composed of them, as will be seen by looking at the analysis of these substances, which I shall hereafter give; nor will a mixture of silica and pure alumina, in the proportions in which these substances are found in clays, (pipe clay, for instance, being a compound of one part of alumina, and three of silica,) calcined or uncalcined, be found to set and harden, when tempered with lime, and placed under water, so well as those substances do separately, as before stated; but they all do harden, more or less. We will hereafter explain the cause of their different behaviour; at present, we will endeavour to show why or how, they harden at all.

Chemists have stated as a general law, that when any two substances enter into chemical combination, one or both of them must be, at the time, in a state of fluidity. I have never seen it stated, but, from long consideration I believe it to be the fact, that when three or more substances enter into chemical combination, two or more of those substances must be then, or have been at some previous time when in contact, in a fluid state.

Now, to apply this law, is to explain the rationale of the hardening of water mortars. The hydrate of lime, a solid, is mixed with the tarras, or puzzolano, or, in other words, is associated with silex, another solid, and placed in fluid water; now, the lime is soluble in this water, and its solution, coming into contact with the remaining solid, (silex,) for which lime has a greater affinity by far than for water, it quits the water, and attaches itself to the silex, and the water, being again at liberty, dissolves another portion of lime, to be again, in its turn, attached to the silex; and, in favourable circumstances, this proceeds till the soft mixture is indurated, and becomes a hardened mass.

That this is a true and faithful representation of the wonderful change produced in these substances, is rendered undeniable by the following experiment, which I made to test the opinion just given.

Into a basin of water, was introduced a plate of glass, on which was laid small and separate particles of coarse grains of tarras, of puzzolano, of silex, of alumina, of protoxide of iron, or common forge scales, of coarse fragments of Roman cement, and other substances likely to attract the lime, and to concrete with it into masses; and on another part of the glass was laid a small piece of quick-lime, which, slacking, was dissolved by the water; the water soon became saturated with lime, covered with a protecting coat of carbonate; the lime was attracted with more or less force to the different, distinct, and distant substances, from the water, and there were, after the lapse of a few days, found concrete masses of lime, and of the respective substances, more or less advanced in hardness, and the hardness so obtained was in direct proportion to, and was an evident measure of, their respective

affinities for lime; and are evidently, also, superior to that existing between lime and water. Now, this experiment accounts perfectly for the hardening of water mortars, for their ceasing to harden when withdrawn from water, and for their again continuing to harden when replaced in water. Why they sometimes continue to harden out of water, and sometimes to retrogade, as well as why tarras and puzzolano harden better than the principal elements of which they are composed, whether those elements be combined or uncombined, will all be satisfactorily shown when we have made some necessary farther advances in our inquiries.

On Surrendering and Renewing Patents under Amended Specifications. By the Editor.

In the last volume of this Journal, p. 313, in noticing a patent obtained by Mr. C. J. Gayler, of New York, for manufacturing iron chests, we remarked that the patent originally issued to Mr. Gayler for these chests, had been vacated in the District Court of the United States for the Southern District of New York, in consequence of defects in the specification, and expressed a doubt whether, under these circumstances, the new patent could be sustained. By referring to the notice here alluded to, the reader will find a brief statement of the grounds upon which that doubt was founded. Our attention has been since called to this subject, and upon further reflection we are apprehensive that our first impressions upon this point may prove to be incorrect; we have also conversed with two gentlemen of the bar respecting it, who believe that a patent which has been declared void by a court, may, under the act of July 3d, 1832, be surrendered to the Secretary of State, and reissued under an amended specification. This act provides that whenever a patent "shall be invalid or inoperative, by reason that any of the terms or conditions prescribed in the third section of the act [of February 21st, 1793] have not, by inadvertence, accident, or mistake, and without fraudulent or deceptive intention, been complied with on the part of the said inventor, it shall be lawful for the Secretary of State, upon the surrender to him of such patent, to cause a new patent to be granted," &c.

All the patents which had been surrendered subsequently to the passing of this act, and prior to that by Mr. Gayler, were, we believe, surrendered upon a conviction existing in the mind of the patentee, that he had not complied in the first instance with the requirements of the law, and that his patent would not, therefore, be sustained if carried into court. There does not, however, appear, in the wording of the law, any thing to prevent the surrendering of a patent after it has been declared void by a jury, as this does no more than prove it to be "invalid and inoperative," and appears, therefore, to place it in the precise condition in which the relief contemplated by the act is to be afforded. Until this has been done, the patent is not absolutely "invalid and inoperative," however strong the conviction may be that such would prove to be its condition, if subjected to the ordeal of the law.

The foregoing view of the operation of the law appears to be much more consonant with justice than that first taken by us, as a patentee might, undoubtedly, surrender his patent, had his errors been discovered by himself, or by his friends, and it would be no small hardship, were the remedy denied because they had been detected by an adversary.

It may be proper to observe, that a reissued patent stands precisely upon the same basis with that originally obtained; that is to say, the surrender and reissuing do not of themselves give to it any validity, but only afford an opportunity to render it valid. The patentee may still claim more than he has invented, or the whole thing patented may be without novelty, and stand no better chance of being sustained than it did in the first instance. We could point to several reissued patents, which we believe to be in this predicament, and which must remain so, until the Ethiopian can change his skin, and the leopard his spots.

Physical Science.

Essays on Meteorology. By JAMES P. ESPY, Mem. Am. Philos. Soc., &c.

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN,—I send you now, for publication, the first of a series of essays on rain, hail, and snow, water-spouts, land-spouts, winds, and barometric fluctuations, in which, I hope, it will be found that I have successfully traced these phenomena to their true causes.

The announcement that these essays were about to be published, was made in a communication of mine, in the Journal of the Franklin Institute, in 1834, and they have only been withheld with a view to accumulate such a mass of facts, as would place the theory on an immovable foundation. Such a mass has now been collected, and I promise the reader, in advance, that he will find developed in the following essays, a law in meteorology, which, founded on acknowledged dynamical principles, explains at once, with a simplicity which nothing but nature can equal, all the *seven* phenomena mentioned above.

The importance of this law will readily be admitted, when it is understood that by it may be known whether there is a great storm raging at any time within four or five hundred miles of the observer, and also the direction of that storm, with the means of avoiding it, if the observer is at sea.

Yours, &c.

JAMES P. ESPY.

No. I.

Theory of Hail.

It has been shown by the experiments of Berard and Delaroche, and also by those of Clement and Desormes, that the specific heat of atmospheric air is about .250, that of water being one.

Now, if these experiments are correct, and they appear to be so, it will be easy to account for the formation of rain, snow, and hail, and several other atmospheric phenomena, which have never yet been satisfactorily explained.

The theory of these meteors may be given in a few words. When a portion of transparent vapour, in the air, is condensed into cloud, or water, *the latent caloric given out expands the air containing it six times as much as it contracts by the condensation of the vapour into water.*

This general principle will be most easily explained by calculating a particular case. Suppose the weight of vapour in the air to be one-sixty-fourth that of the air, which is the fact when the dew-point is about 71° Fah. Now,

if all this vapour should be removed from the air, the diminution of bulk, on the supposition that the specific gravity of vapour is .625°, that of air being one, would be .045 of the whole.

As it is known that the sum of the sensible and latent caloric of the vapour of water is always equal to 1212° Fah., if we subtract 71°, the dew-point assumed above, from 1212°, it will leave 1141° for the latent heat of vapour at the temperature of 71°. As this latent heat would raise the temperature of sixty-four times its weight of water, 17.8°, it will raise the air in which it is supposed to be condensed, four times that quantity, or 71.2°. Now, if air at the temperature of 32° be raised 71.2°, it will be expanded 0.15ths of its whole bulk, nearly, which is six times its contraction from the condensation of its vapour into cloud, or water.

The calculation here made is undoubtedly low, for the mean temperature of the air to which it is intended to apply, as will be seen hereafter, is below 32°, and though the capacity of air is increased by a diminished pressure, yet it is believed that that increase will be more than counterbalanced by the 140° of heat given out, in the case of hail, at the moment of congelation, for which no allowance is made in the above calculation.

It follows, then, from the principle here demonstrated, that the moment a portion of transparent vapour in the air begins to condense into cloud, the air in which it is contained begins to expand, and, consequently, if an equilibrium existed before, it is now destroyed, and the cloud will continue to ascend as long as its temperature is greater than that of the surrounding air.

Without examining its condition every instant of its ascent, let us imagine it to have ascended three miles and a half, or 6000 yards, where the pressure of the surrounding air is about half that at the surface from which we suppose it to set out. In consequence, then, of occupying a double space, the dew-point would be 50°, provided none of the vapour is turned to water. On the same supposition, the temperature of the air would fall, in consequence of expansion, one degree for every hundred yards of ascent, if it preserved the same relative temperature to the surrounding air which it had at first, and its temperature would then be 11°. But this temperature is impossible with a dew-point of 50°, for the temperature could not fall below 50°, without bringing the dew-point with it.

From necessity, therefore, the dew-point must fall below 50°, to a point where latent caloric enough is evolved by the condensation of vapour, to heat up the air from 11° to that point.

I find, by calculation, that if the dew-point sinks sixteen degrees below 50°, $\frac{121}{373}$ths of the whole vapour in the air will be condensed, and this will heat the containing air 23 degrees, the excess of which over the 16 degrees of depression will make up the difference between 11° and 50°. Thus it appears that the temperature of air, when it has ascended 6000 yards, with a dew-point of 71° at its commencement, will have a dew-point of 34 degrees, and be 23 degrees warmer than the surrounding air at that elevation. In like manner it may be shown, by assuming other points at greater elevation in this upward motion, that the difference of temperature between the air in the vortex, and the surrounding air, is constantly increasing with the elevation, until the moment when the vapour is all condensed into water, when it will be 71.2° higher, as was shown before. After it passes this point, it will continue its motion upwards, *dry*, and, of course, not increasing in temperature beyond 71.2° higher than the surrounding air, but will

preserve this difference until it reaches the surface of the atmosphere, where it will spread itself out, and come to rest. We have now a column of air reaching from the surface of the earth to the surface of the atmosphere, of the same temperature as the surrounding air below, and 71.2° greater above, making a mean of 35.6°. Now, the mean temperature of the surrounding air may be taken as low as 32 degrees, and, consequently, the expansion due to these 35.6° will be $\frac{356}{480}$ths of the whole height of the atmosphere; and as the atmosphere would be 27,000 feet high, if it were throughout of the same density as at the surface of the earth, the expansion will be $\frac{35.6}{480}$ of 27,000 feet = 2070 feet. This vortex column, then, is pressed upwards with a force equal the weight of a column of air of the density at the earth's surface, 2070 feet high, and will move upwards, as is demonstrated in mechanics, with a velocity in feet per second = $\sqrt{2070} \times 8 = 364$, which is 4.13 miles per minute, or 218 miles per hour. Nor is this great velocity at all incredible, for the upward motion in the vortex is as much greater than the horizontal motion of the air towards the vortex, as the motion of the air in a chimney is greater than the horizontal motion of the air in the room towards the fireplace.

I am aware that several corrections would have to be made to the numbers used above, if strict numerical accuracy were my object. For example, it is probable that the air in the higher regions contains, as Mr. Ivory asserts, more caloric to the pound than in the lower regions, for it is the upper air which receives the latent caloric given out in rains, and snows, and hails; but this correction would vary the result so little, that, for the sake of simplicity, I have chosen to neglect it. Besides, the truth of the theory does not at all depend on the numerical accuracy of the above calculation. It is believed, indeed, that the latent caloric given out by congelation, would, after all the other corrections were made, be sufficient to turn the scale in its favour; but, even if it should be found otherwise by a closer investigation than I propose now to give the subject, the truth of the theory cannot be touched, unless it shall be discovered that the experiments on the specific caloric of atmospheric air, mentioned above, are erroneous to a degree altogether incredible. For, if the capacity of air should be found to be four times as great as supposed above, I find, even then, that the latent caloric given out on the formation of a cloud, would cause an expansion just double the contraction from the condensation of the vapour, and *that*, too, without the assistance of the caloric given out by congelation. And even this small expansion, calculated on the principles laid down before, would give an upward velocity of 100 miles per hour.

As the result here deduced is so extraordinary and unexpected, it will, no doubt, excite chemists to determine, with the greatest care, the specific caloric of atmospheric air, as this is the only point concerning which any doubt remains, on which the theory advocated depends. The latent caloric of vapour, the expansion of air by heat, and its velocity upwards for a given expansion, are perfectly known.

In the meantime, let us see how the theory will explain the phenomena. It is confidently believed that no theory will stand the test of examination, which will not show how, in the case of hail, drops of rain are first formed, and then frozen. This theory readily accounts for this circumstance; for, when the dew-point is high, and near the temperature of the air, condensation of the vapour into drops of rain will take place near the surface of the earth, in the ascending vortex, and these drops will increase in size until they are carried up far beyond the region of perpetual congelation, where

they will be frozen. That very large drops will be carried up while they are in the ascending vortex, will readily be admitted, when it is recollected that the velocity of the ascending vortex was demonstrated to be about 364 feet per second, even when the dew-point was taken at 71 degrees. If the dew-point had been taken at 80 degrees, a much greater velocity would have been the result. It is known by experiment, that when common atmospheric air moves with a velocity of one foot per second, its impulse on a square foot of surface, perpendicular to its motion, is sixteen grains; and as the force of all fluids is as the square of their velocity, the force of air in the vortex, on the supposition of its density being equal to common air, would be $\overline{364}|^2 \times 16$ grains, about 361 lbs. on each square foot of surface. But as the air in the vortex, at the height to which hailstones may be carried, is probably not more than one-third the common density, the actual force of upward impulse, at this great elevation, is only one-third of 361 pounds to the square foot; a power still sufficient to raise a cube of ice one and a half feet in diameter.

I hope it will not be considered a decisive proof against my theory, if it fails to account for hailstones, said to have fallen in the reign of Charlemagne, fifteen feet long, six feet wide, and eleven feet thick; nor of those which fell, or are said to have fallen, in the reign of Tippoo Saib, as large as elephants; for these accounts are probably exaggerations.* And yet, if we suppose the vortex perpendicular, and the dew-point high, its power would be sufficient to raise an elephant some distance, but certainly not so high as the region of perpetual congelation. We have certainly many authentic accounts of hailstones weighing half a pound, and more. Pouillet has given an account of a hail storm which extended from the Pyrenees to the Baltic, on the 13th of July, 1788, in two bands, parallel to each other, about fifteen miles apart, in which space there was a great rain. The eastern band was, at a mean, about six or seven miles broad, and the western about twelve miles. The rain, however, was on the outside of these bands of hail, as well as between them. The progress of the storm from the south-west to the north-east was about fifty miles per hour, and the hail continued to fall not more than eight minutes at any one place, yet the devastation was immense, the largest of the hailstones being about eight ounces.

If I had made this storm myself, it would be said that I had made it to illustrate my theory. For it is manifest that the out-spreading of the vortex above, will, in many cases, carry with itt he hailstones, and those which are least the farthest, and these smaller hailstones, on the outside of the bands, will melt before they reach the earth, while the larger hailstones, falling more swiftly, and having more ice to melt, may reach the earth in the form of hail. Thus the two veins of hail, and the rain on the outside of them, are manifestly accounted for; it is not quite so plain why it should only rain in the middle. Nevertheless, if we consider that the vortex moved with a velocity of fifty miles an hour from the south-west to the north-east, we will readily perceive that, as it would require perhaps twenty or thirty minutes for the drops of rain to be carried up to their greatest elevation, and to fall down to the earth, during which time the vortex would move forward twenty or twenty-five miles, neither hail nor rain could appear in front of the vortex, and as it could not fall in the middle of the vortex, being prevented by the force of the ascending air, whatever fell between the two bands of hail

* Pouillet, vol. iv., p. 836, et seq.

must have descended in the hinder part of the vortex, where the resistance might have been so great to its descent in the lower parts of the air, as to cause it to melt before it reached the earth.

The correctness of this explanation acquires additional probability from the fact that, in hail storms, the hail almost always precedes the rain, as appears from the facts collected by Pouillet. After mentioning the facts connected with this remarkable storm, this highly enlightened philosopher says: "In explaining the meteor hail, there are but two difficulties, but these are great, and we may say, in advance, they remain above all the efforts which have been made to resolve them.

"First. To explain how the cold is produced which congeals the water, and then to show how a hailstone which has acquired sufficient volume to fall by its own weight, remains yet suspended in the air during all the time necessary to acquire a volume fourteen or fifteen inches in circumference."

These two difficulties have already been fully explained. But the power of the theory does not stop here. It explains all the showers of dust, and rains of blood, (which are only water holding clay in solution,) of which we have a great many well authenticated accounts. For, when the vortex reaches down to the surface of the earth, it is able to carry up large quantities of earth, as will appear from the following extract: "On the 6th of July, 1822, at 35 minutes past 1 o'clock, P. M., in the plain of Ossonville, six leagues WSW. of St. Omer, and six leagues SE. of Boulogne, clouds were seen coming from different directions, and uniting together rapidly over the plain; they soon formed but *one*, which covered the horizon. An instant after, they saw descend from this cloud a thick vapour, having the blueish colour of sulphur in combustion; it formed an inverted cone, whose base was in the cloud. After it passed from that place, it was discovered that it had made an excavation in the earth, in the form of a basin, twenty or twenty-five feet in circumference, and three or four feet deep in the middle. After tearing down a barn, and some trees, it passed on, a distance of two leagues, without touching the earth, carrying with it large branches of trees, which it threw out to the right and left with much noise. Having then arrived at an elevated wood, it tore off the tops of many oaks, and carried them over the village of Vendome, situated at the foot of the hill, on the east side of the forest. In this commune, it tore up by the roots a large sycamore, and carried it 600 yards. The meteor, during its whole course, was like a bullet, which strikes the earth, and rebounds, tearing up the earth in places, and from time to time throwing out from its centre globes of fire, and globes of sulphurous vapours, and branches of trees. In the village of Witcanestre, of forty houses, thirty-two were prostrated, with their walls all thrown outwards, and at Lambre, eighteen, chiefly built of bricks, were sapped to their foundations in the same extraordinary manner." Nothing is said of either hail or rain accompanying this meteor.

Another spout, almost exactly similar to this in violence, took place near Treves, on the afternoon of the 25th of June, 1829. Suddenly, from the middle of a black cloud, about 20° above the horizon, a luminous mass began to move in an opposite direction, and to tear it open violently. The cloud near the top very soon took the form of a chimney, from which escaped a smoke of a whitish gray, mingled, at intervals, with jets of flame, and rising through several openings, with as much force (so several witnesses express themselves) as if it had been driven with great force by several bellows. It had not gone far, when a new meteor, as some thought, appeared

in contact with the ground, nearly under the other, though a little behind, and producing great destruction.

One man, who was prostrated by the spout, affirms that there were two currents, in contrary directions. The path of the meteor was from ten to eighteen yards wide, as marked on the earth, and about 2100 yards long. It lasted about eighteen minutes, and, as seen at the distance of a mile and a half, it had the form of a serpent, of a hundred and forty feet long, with its head towards the NNE., and its tail opposite. It disappeared suddenly, and without explosion, and, almost immediately afterwards, hailstones of extraordinary size fell in the woods, to the NNW. of the place where the spout had passed. The sun did not appear during this whole time, and there was not a breath of air; at least, so several of the spectators affirm.

The various phenomena accompanying these two spouts seem to me to favour, in a most remarkable manner, the fact of upward motion; especially the manner in which the houses were prostrated by the first. Indeed, this latter phenomenon appears to me to be an experimentum crucis,—to prove that a light column of air was suddenly brought over the houses, thus prostrated; and by thus diminishing the pressure on the outside of the house, the elasticity of the air within produced an explosion, prostrating the walls outwards, and carrying off the roof.

An upward force which could carry off a large sycamore many hundred yards, must have been quite adequate to produce this effect, if it could be brought to act instantaneously, or even very suddenly, which, in the present case, the whole description of the phenomena induces me to believe was the fact. Now, the diminution of the weight of the column in the vortex, as estimated above, is more than a pound to the square inch, where the dew-point was assumed at 71°, which is a very moderate case, as the dew-point is frequently 75°, and sometimes as high as 80°, in this climate. Besides, a friend of mine informed me, that in a violent storm in Delaware Bay, he observed his barometer at 27 inches, which amounts to a pound and a half diminished pressure on a square inch; and it will appear, hereafter, that the barometer stood as low as 28 inches, near the termination of a spout in the Orkneys. If we take this low estimate, which gives one pound to the square inch, the force on a wall of a house from within, outwards, at the moment the vortex comes over it, supposing it to be 20 feet high, and 30 feet long, would be 46,120 pounds. One-tenth of this force would prostrate an ordinary wall.

Windows, also, have been known to have been burst open outwards, in this country, by a violent and narrow storm, attended with hail, even when the houses were not thrown down; but as this might sometimes occur when an open door might be directed to a horizontal current, it is not adduced here as proof positive that this effect was produced by an upward vortex. Nevertheless, as the same spout which burst out windows, also lifted up, and carried to a great distance, heavy materials, these facts may well be adduced as *favourable* to the theory. In one case, however, which may be considered very strong in favour of the theory, the roof was taken off from a barn, and the grain in the inside carried out at the top, without the walls being thrown down.

In the eighty-eighth volume of the Journal de Physique, page 274, is an account of a great many spouts, both by sea and land. One of these, in the the south of France, unroofed eighty houses, dispersed through the country the sheaves of corn which it carried out of a barn, broke the doors and win-

dows of a chateau, and tore up the pavement in the middle of a room, without deranging some piles of china ware in it.

No one can doubt that the hail which fell almost immediately after the passage of the spout, was connected in some way with the spout itself. The manner of its connexion is fully explained by the theory. And even the perfect calm which reigned a short distance beyond the borders of the spout, which, in this instance, was very narrow, may easily be imagined from the outspreading of the air above, causing an increased pressure on the barometer, and thus preventing the air, beyond a certain distance, from moving towards the spout at the surface of the earth, and beyond this point, even causing it to move in an opposite direction.

The direction, also, in which the latter spout leaned, may also be accounted for on supposition that the upper part of it reached the current of air which, in higher regions of the atmosphere, is always moving from the south-west to the north-east; for, as soon as it reached that current, its upper part would be blown in that direction, and the spout itself would have to move in that direction with it. Moreover, the spout would be stationary, if it was formed in still air, until its upper part should reach this upper current, which might be twenty or thirty seconds, and this will account for the excavation of the earth under the place where the spout was seen to be formed.

Again, the theory will account for the rebounding of the spout,—that is, of its sometimes reaching the surface of the earth, and sometimes not. For, where the dew-point was very near the temperature of the air, *there* a very slight rarefaction of the air would produce cold enough to cause a condensation of the vapour, and so the vortex, with its condensed vapour, would be seen to reach the earth, and vice versa, where the dew-point should be many degrees below the temperature of the air.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Computations of the Principal Phases of the Solar Eclipse of May 15th, 1836, for several places in the United States. By SEARS C. WALKER, Esq.

The following computations of the principal phases of the solar eclipse of May 15th, 1836, have been made by E. O. Kendall, and duplicates of several of them by H. Wilson, from formulæ which I have prepared from the elements in the Nautical Almanac, after the method of Mr. Woolhouse. The beginning, greatest obscuration, and end, are given in mean solar time, May 15th, A. M., civil reckoning. I have examined them, and believe them to be correct.

	Beginning.	Greatest Obscuration.	End.	Digits eclipsed on Sun's south limb.	Latitude and Longitude.
Philadelphia,	7h. 3m. 32.8s.	8h. 13m. 26.1s.	9h. 32m. 17.8s.	7° 51′ 34″	39° 56′ 59″
	319° 31′ 18″		103° 41′ 41″		5h. 0m. 43.9s.
Baltimore,	6h. 56m. 20.8s.	8h. 5m. 16.4s.	9h. 23m. 1.1s.	7° 45′ 18″	39° 17′ 15″
	319° 56′ 49″		103° 6′ 19″		5h. 6m. 31.3s.
Washington,	6h. 53m. 51.5s.	8h. 2m. 32.9s.	9h. 20m. 05.1s.	7° 45′ 45″	38° 52′ 54″
	319° 53′ 14″		103° 10′ 11″		5h. 8m. 7.2s.
Harrisburg,	6h. 57m. 50.0s.	8h. 6m. 27.7s.	9h. 23m. 30.8s.	7° 34′ 3″	40° 16′
	320° 47′ 23″		101° 55′ 15″		5h. 7m. 20s.
Lancaster, Pa.	6h. 59m. 13.4s.	8h. 8m. 14.6s.	9h. 25m. 54.7s.	7° 40′ 29″	40° 2′ 36″
	320° 19′ 50″		102° 34′ 54″		5h. 5m. 22.2s.
Pittsburgh,	6h. 45m. 48.7s.	7h. 51m. 59.4s.	9h. 5m. 21.5s.	7° 3′ 29″	40° 32′
	322° 55′ 1″		98° 44′ 32″		5h. 20m. 32s.
Detroit,	6h. 39m. 31.1s.	7h. 43m. 29.1s.	8h. 52m. 30.1s.	6° 24′ 30″	42° 24′
	325° 49′ 8″		94° 25′ 32″		5h. 31m. 52s.
Buffalo,	6h. 55m. 59.0s.	8h. 2m. 42.8s.	9h. 16m. 5.5s.	6° 52′ 57″	42° 53′
	323° 47′ 54″		97° 29′ 59″		5h. 15m. 40s.
Rochester,	7h. 0m. 39.7s.	8h. 8m. 7.6s.	9h. 22m. 31.4.	6° 59′ 30″	43° 8′ 47″
	323° 21′ 14″		98° 10′ 21″		5h. 11m. 24s.
Troy,	7h. 15m. 59.6s.	8h. 26m. 31.3s.	9h. 45m. 28.5.	7° 38′ 13″	42° 44′
	320° 36′ 26″		102° 9′ 32″		4h. 54m. 40″
Schenectady,	7h. 15m. 9.7s.	8h. 25m. 30.2s.	9h. 44m. 10.2s.	7° 35′ 30″	42° 48′
	320° 48′ 23″		101° 52′ 40″		4h. 55m. 40s.
Princeton,	7h. 6m. 32.4s.	8h. 17m. 6.6s.	9h. 36m. 22.9s.	7° 52′ 47″	40° 22′
	319° 29′ 41″		103° 47′ 18″		4h. 58m. 20s.
Trenton,	7h. 6m. 18.3s.	8h. 16m. 30.7s.	9h. 35m. 46.9s.	7° 53′ 31″	40° 14′
	319° 26′ 13″		103° 52′ 6″		4h. 58m. 36s.
Haverford, Pa.	7h. 3m. 5.5s.	8h. 14m. 41.4s.	9h. 31m. 24.4s.	7° 49′ 17″	40° 1′ 12″
	319° 43′ 3″		103° 27′ 56″		5h. 1m. 26.8s.
Wilmington, Del.	7h. 1m. 49.1s.	8h. 11m. 31.2s.	9h. 30m. 14.9s.	7° 51′ 40″	39° 41′
	319° 32′ 1″		103° 43′ 18″		5h. 1m. 52s.
Newcastle, Del.	7h. 1m. 31.2s.	8h. 11m. 9.9s.	9h. 29m. 49.1s.	7° 51′ 7″	39° 40′
	319° 34′ 16″		103° 40′ 0″		5h. 2m. 8s.
Dover, Del.	7h. 0m. 20.8s.	8h. 10m. 15.1s.	9h. 29m. 11.7s.	7° 56′ 30″	39° 10′
	318° 47′ 50″		104° 13′ 45″		5h. 2m. 0s.

These phases have been computed from the equations,

$\cos \varpi = 1.11107 - [0.16621] \sin l + [0.00414] \cos l \cos (\lambda - 56° 49'.5)$

$\cos \varpi' = 0.95633 - [0.15790] \sin l + [0.02242] \cos l \cos (\lambda - 41° 27'.9)$

$\cos \varpi'' = 0.70356 - [0.15000] \sin l + [0.03777] \cos l \cos (\lambda - 23° 38'.2)$

$t = 1\text{h. } 57\text{m. } 24.0\text{s.} = + [3.53968] \sin l - [3.82162] \cos l \cos (\lambda + 82° 43'.0) - [3.62430] \sin \varpi$

$t' = 1\text{h. } 56\text{m. } 10.5\text{s.} = + [3.61296] \sin l - [3.86356] \cos l \cos (\lambda + 98° 46'.5) + [3.72245] \sin \varpi'$

$t'' = 1\text{h. } 35\text{m. } 45.1\text{s.} = + [3.68288] \sin l - [3.90746] \cos l \cos (\lambda + 116° 59'.5) + [3.72245] \sin \varpi''$

Where,—

l = the latitude of a place + North — South
λ = the longitude from Greenwich + East — West
$(12\text{h.} + \lambda) + t$ = the local mean time of beginning, A. M. May 15.
$(12\text{h.} + \lambda) + t'$ = the " " " greatest obscuration.
$(12\text{h.} + \lambda) + t''$ = the " " " end.
$209° 18' 13'' - \alpha$ = angle for beginning.
$211° 12' 37''$ = position of moon's centre for greatest obscuration.
$212° 52' 26'' + \alpha''$ = angle for end.
$[4.62355]\ (1 + \cos \alpha')$ = digits eclipsed on sun's south limb.

The above angles of position are reckoned from north to the right, round the circle, as seen in a telescope that inverts.

In these equations, α, α', α'', for the United States, are to be taken in the second quadrant. The sum of the apparent semi-diameters has been diminished 5″. If this correction for irradiation be rejected, the beginnings will take place 12.1s. earlier, and the ends 15.1s. later, than the times above given. These results agree very nearly with the rigorous computations in the American Almanac, and with the approximate computations in the same, with the single exception of Pittsburg, at which place, the beginning, greatest obscuration, and end, will take place thirteen minutes earlier than the times given in that publication.

Philadelphia, March, 1836.

Franklin Institute.

Minutes of the Board of Managers.

At a meeting of the Board of Managers, held at the Hall of the Institute, January 26th, 1836,

Mr. Matthias W. Baldwin was elected Chairman of the Board; and Messrs. Frederick Fraley, and John C. Cresson, Curators, for the ensuing year.

And at a meeting of the Board, held February 17th, the Chairman nominated the Standing Committees, agreeably to the by-laws. On motion, Mr. Matthias W. Baldwin was added to the Committee on Publications, and Mr. Jacob Peirce, and Professor Henry D. Rogers, to the Committee on the Cabinet of Minerals; when the committees were appointed, as follows:—

On the Library.

Mordecai D. Lewis,	William B. Reed,
Isaac Hays, M. D.	Alexander M'Clurg,
J. Henry Bulkley,	Earl Shinn.

On the Cabinet of Models.

John Agnew,	John C. Cresson,
John Struthers,	Isaac P. Morris,
Joseph S. Walter, Jr.	Andrew M. Eastwick.

On the Cabinet of Minerals.

Isaiah Lukens,	Samuel Hufty,
Abraham Miller,	Jacob Peirce,
William H. Keating,	Henry D. Rogers.
John C. Trautwine,	

On Publications.

Alex. Dallas Bache, M. W. Baldwin,
Samuel V. Merrick, Rufus Tyler,
Isaac Hays, M. D. John C. Trautwine.

On Premiums and Exhibitions.

John C. Cresson, Isaac B. Garrigues,
Joshua G. Harker, Alexander M'Clurg,
William H. Keating, Alexander Ferguson.
Frederick Fraley,

On Instruction.

Frederick Fraley, Joseph S. Walter, Jr.
Rufus Tyler, James M. Linnard,
John Wiegand, Isaac P. Morris.
Mordecai D. Lewis,

On the Monthly Meetings.

Isaac Hays, M. D. Benjamin Reeves,
Alex. Dallas Bache, John C. Cresson,
Rufus Tyler, A. M. Eastwick.

Managers of the Sinking Fund.

Samuel V. Merrick,
Frederick Fraley,
Alexander Ferguson.

Auditors.

Isaac B. Garrigues,
Joshua G. Harker.

(Extract from the minutes.)

M. W. Baldwin, *Chairman.*

William Hamilton, *Actuary.*

Committee on Science and the Arts.

Report on Mr. A. C. Jones' Spark Arrester.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, an apparatus for stopping the sparks from the flues of locomotive engines, invented by Mr. Alfred C. Jones, of Portsmouth, Virginia,

REPORT:—

That it has for some time been considered a desideratum to devise a plan by which the sparks escaping from the chimney, or smoke pipe, of a locomotive engine, may be arrested, so as to ensure both the comfort of passengers, and the safety of goods, transported on rail-roads. The rapid extension of this mode of conveyance, is every day rendering this object of increased importance. Judging from the certificates of engineers and others, exhibited by Mr. Jones, it may be inferred that he has been more successful in relation to it, than preceding inventors.

The principal peculiarities of Mr. Jones' invention, are the following.

1. A projection, and funnel shaped opening, in the front part of the wire gauze, which surmounts the smoke pipe. This opening is for the purpose of admitting the external air to mix with the escaping smoke and steam, and is supposed to have the double effect of cooling and condensing the smoke and steam, so that it will not burn and destroy the wire gauze, and of pro-

ducing a horizontal, or backward, current of air, which throws the sparks into the receptacle hereafter described.

2. A peculiar shape in the wire gauze cap, extending a considerable distance backward, over or beyond the back of the top of the smoke pipe, which affords a space for the sparks to be thrown down into the receptacle hereafter described, the shape of the back part of the cap, or wire gauze, being such that the sparks do not strike it perpendicularly, but obliquely to its surface, and thus are thrown down, instead of passing through the apertures.

3. A receptacle for sparks, back of the top of the smoke pipe, and under the back part of the gauze cap, at the lower part of which receptacle is a pipe, extending downward into the smoke chamber at the end of the boiler, and below the part immediately connected with the boiler. Through this pipe, the sparks pass, and fall into the bottom of the smoke chamber. It is supposed by Mr. Jones, that the impetus of the steam, escaping from the engine, through the smoke pipe, produces a partial vacuum in the bottom of the smoke chamber, and causes a portion of air to rush down the said pipe, which makes the sparks the more readily descend, to a place where they are beyond the influence of the escaping current of smoke and steam, there to be consumed.

4. The gauze cap is made with hinge joints, so as to be thrown over backward, when the engine is not under way. This contrivance serves the double purpose of preventing the gauze from being clogged with lampblack, by the thick smoke escaping before the starting of the engine, and of facilitating the cleansing of the gauze, by a brush applied to its inner surface, where the smoke and lampblack condenses.

It is the opinion of the committee, that each of the foregoing features is productive of advantage. Hence, they are of opinion that Mr. Jones' apparatus is among the best that has been devised; an opinion which is confirmed by the respectable testimony which has been adduced.

There is a suitable apparatus for arresting the sparks when the engine is going backward, which it is deemed unnecessary here to describe.

By order of the committee.

January 14, 1836. WILLIAM HAMILTON, *Actuary.*

Report on Mr. L. V. Badger's Hot Air Forge.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, the Hot Air Forge, invented by Mr. L. V. Badger, of Portsmouth, New Hampshire, REPORT:—

That this forge consists of a hollow cast-iron hearth and back, divided by a number of air-tight partitions, so as to form, for the passage of the blast, one continuous square channel; this channel traverses both the back and the hearth. The air from the bellows, entering by the back, must flow between the partitions, doubling backwards and forwards, and passing the elbows between the back and hearth, until it reaches the tuyere, after nine changes in its direction. There are two tuyere holes, one at the corner of the back and hearth, the other considerably higher up in the back. The air from the lower tuyere flows out, through twenty small perforations, in a convex, hollow, false hearth, which is retained between two guides, and can be removed for the purpose of cleaning it.

The arrangement by which the air is made to traverse the hollow back and hearth, in order to cause it to enter the fire at an increased tempera-

ture, is neat and simple, but, in the opinion of the committee, ineffectual to produce the object. The amount of heated surface past which the air must flow, is so small, and the temperature itself of much of the back and hearth so low, as not to justify the anticipation of any material improvement in the temperature of the blast entering the fire. But any increase of temperature thus procured, will be more than counterbalanced, it is believed, by the important reduction in the force and velocity of the air, caused by the numerous turns and angles which it must surmount in reaching the tuyere. It is apprehended that the loss of blast from this source, is the radical defect of the proposed forge, while no commensurate gain can be exhibited from the augmentation of temperature.

There appears, also, to be an evil incident to the construction of the false hearth, namely, that the slag will be apt to choke up the perforations, more especially at each time that the hearth is permitted to chill.

By order of the committee.

February 11, 1836. WILLIAM HAMILTON, *Actuary.*

Mechanics' Register.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN SEPTEMBER, 1835.

With Remarks and Exemplifications by the Editor.

1. For a *Lever Press;* Jonathan Payne, Russelville, Logan county, Kentucky, Sept. 9.

This lever press, it appears, has been the subject of an arbitration under the ninth section of the patent law of February, 1793, relating to interfering applications, which terminated in favour of the above named patentee. The construction of the press is pretty clearly made known in the specification, but no claim is there made to any part of it. It is intended for cotton, hay, tobacco, &c. &c. and is constructed as follows. A stout sill, from 30 to 50 feet in length has, rising from the middle of it, two upright pieces of timber 10 feet high, which serve to sustain a lever, or beam, between them of the same length with the sill, and measuring 12 by 18 inches. A stout pin, serving as a fulcrum passes through the upright cheek pieces, and through the beam. Either end of this beam may be drawn down by means of a rack and wheel work, the latter being sustained by the sill, and the former depending from the lever. A pinion, probably of 4 or 5 inches in diameter, turned by a winch, gears into a wheel of 7 feet diameter, having a pinion on its axle of 6 or 7 inches diameter, which acts upon the rack.

No directions are given for using this press, but as only one end of the beam can be employed at a time, the rack and gearing must at one end be used to raise, and at the other to depress the beam, between which and the sill the pressing must, necessarily, be effected.

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2. For a *Churning and Washing Machine;* Thomas Ling, Winthrop, Kennebec county, Maine, September 9.

This is a swinging, or pendulum churn, which really has some novelty about it, and even in this fact alone, their is something cheering, as originality has long been a rare element in churns and washing machines.

The churn is a round tub suspended vertically within a frame, so that it

can swing like a pendulum. A vertical shaft within the tub carries dashers, as is the case in many other churns. To cause the dashers to operate, the shaft projects above the tub, and a string, or cord, passed once or twice round it, the two ends of the string being attached to opposite sides of the frame; on vibrating the tub, the string operates like a drill bow, as will be readily perceived. The claim is to "the modification and combination of the swing or pendulum churn and the dasher, for churning and washing."

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3. For a machine for *Washing Clothes and Fulling Cloths;* Orrin D. Wade, China, Genessee county, New York; an alien who has resided two years in the United States. September 9.

The clothes are to be put into a box, or trough, through the lid of which there passes a row of upright shafts having flat blocks of wood on their lower ends, which blocks nearly touch each other. A row of horizontal levers, hung upon fulcra, and acted upon by lifters on a revolving cylinder, cause the shafts and their blocks to rise alternately, whilst springs above the levers force them down. This constitutes the whole apparatus, to which no claim is made.

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4. For a machine for *Purifying Potters' Clay;* Adam Weber, Womelsdorf, Berks county, Pennsylvania, September 9.

A cylinder is to be made of wood or metal, the bottom of which is to consist of a sieve through which the tempered clay is to be pressed by means of a piston fitting the cylinder, and forced down by a lever. The machine is claimed, generally, as operating upon the principle, and applied to the purpose indicated.

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5. For a *Revolving Platform for Rail Road;* John Tustin, city of Philadelphia, September 9.

We believe that the mode of construction here proposed has not been made the subject of a patent, but recollect its being proposed, and an opinion given, that the plan would not be approved in practice.

A circular channel is to be made in the bed upon which the platform is to rest, which channel is to be adapted to the reception of round balls, like cannon balls. The revolving platform is to be similarly grooved on its lower side, and placed upon the bed with a sufficient number of balls to be nearly in contact with each other; as a safeguard, there is to be a centre pin.

With a heavy weight upon such a platform there will be much friction, the balls as they revolve passing over very unequal spaces on their touching parts; they will also be apt to overtake each each other, and thus increase the evil.

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6. For a machine for *Shelling Corn;* Elijah Morse, Knox county, Tennessee, September 9.

A roller of cast iron is to revolve horizontally, and upon it there are to be rows of teeth which pass between others on the frame. The feeding, as we suppose, is to be effected by placing the ears upon a concave, hinged cover; whence they are to roll, or be forced, against the revolving shaft; a winch occupies one end of this shaft, and a fly wheel the other. The description is very imperfect, and the drawing, although well executed, must certainly show the teeth of the machine, and some other parts, incorrectly. The claim is to "the application of the roller, and the general construction of the whole machine."

7. For the *Application of Hydraulic Cement, &c.;* Obadiah Parker, city of New York, September 9.

This is an *application patent*, like most of, or nearly all, those obtained for the use of cement. By an application patent, we mean one which might be taken for applying a plaster of some approved salve to the head, another being taken for applying it to the shoulder, and others for all the various divisions and subdivisions of the superfices of the corporeal system. In the present instance are enumerated, "house and store cellars, vaults, small wood-cellars, vegetable cellars, cellars under side walks in cities, vaults in cemeteries, and vaults for milk, and garden cellars; the construction of walls, floors, and roofs of buildings, and walls for enclosure; the construction of locks and guards for canals; the construction of sinks for kitchens, and other purposes;" "which has not been known or used." Indeed! there is novelty in this information, and this, we are well convinced, is the only place in which we shall find it, although eighteen pages are occupied by the specification of these applications, and the claim thereto.

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8. For *Making Artificial Stone, or Marble;* Obadiah Parker, city of New York, September 9.

Pulverized granite, or pulverized marble is to be brought to a proper consistence for moulding into the required form in combination with water lime. This constitutes the INVENTION.

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9. For the *Formation of Artificial Stone and Marble for Architectural Purposes;* Obadiah Parker, city of New York, September 9.

We have again about a dozen pages devoted to the mode of forming various ornamental and useful articles, pavements, &c. &c. by modes analogous to those described in the preceding specifications, and having, consequently, the same claim to novelty, or rather to antiquity. Should the patentee think himself aggrieved by the foregoing remarks, a thing which we do not anticipate, we will offer him a reference to a gentleman in New York, who can tell him much more about the combinations of water lime, and the formation of artificial stone than he now knows; and will give him ample proof that our animadversions, or rather intimations, are founded in perfect truth.

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10. For a *Water Wheel;* Jehiel W. Dart, and Stephen Wood, Truxton, Cortland county, New York, September 9.

This is a kind of re-action apparatus, in which two wheels differently constructed are to be placed one close above the other on the same vertical shaft; the first of these wheels has four floats which revolve in a circular drum through the side of which the water enters tangentically to the circle, and strikes the floats; after performing its labour there, it escapes through a centre hole in a horizontal partition, and enters the ordinary reaction wheel, passing through its curved channels, and escaping at its periphery.

The claim is to "the increase of power which is obtained in the above arrangement of the central discharger, or whirlpool wheel, and the reaction wheel." This is rather an inverted claim, being to the end instead of to the means, but this in the present case is a thing of little consequence.

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11. For an improvement in the *Composition and Manufacture of Gum Elastic Cement;* Charles Goodyear, New Haven, Connecticut, September 9.

After dissolving the gum by means of spirits of turpentine, using two quarts of the spirits to one pound of the gum, magnesia is to be combined with it in the following way. One pound of magnesia is to be sifted through a fine sieve, into about two quarts of alcohol, with which it is to be well incorporated; a proper portion of the magnesia and alcohol is then to be mixed intimately with the dissolved gum, the quantity varying for different purposes, but being generally, in the proportion of six ounces of magnesia to the pound of gum. When applied between cloths, or to vessels to be filled with air, four ounces will suffice. When used to cover cloth on one side, eight ounces is preferred. If the whiter parts of the caoutchouc be taken, a solution will be obtained nearly colourless, and capable of receiving any desired tint.

We are not told that the magnesia is to be calcined, but being used as an absorbent and dryer, we suppose this to be case. This compound, it is said, dries very readily, is not tackey, and has the usual unpleasant odour corrected. The claim is to the application of magnesia.

We have been informed by a manufacturer that he has used magnesia with the solution, repeatedly; whether before it was used by the present patentee, or under such circumstances as to interfere with his patent, we do not know.

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12. For a *Rotary Steam Engine;* John Bennock, Orono, Penobscot county, Maine, September 0.

A circular channel for a piston to revolve in is formed by bolting together two metallic rims, each of which contains one half of the channel turned perfectly true. These two parts are connected by bolts through flanches outside of the circular rim only, those on the inside not being in contact, but so far apart as to allow the flat rim of an interior wheel to be interposed between them; this wheel revolves on an axis passing through the centre of the circular channel, above mentioned, its periphery just reaching it, and having attached to it the revolving piston. Metal rings, inserted in grooves, and borne up by screws, are to be employed as packing against the sides of the interior wheel. A sliding valve, contained in a valve box, is withdrawn to allow the piston to pass, being acted upon by cams on the main shaft. There are, of course, proper openings for the introduction and escape of steam.

The machine is to be doubled, there being two circular cavities with their pistons, and other appendages, but having their valves in reversed directions, that the full action of the steam may always be upon one of them; the same main shaft is to carry both of the piston wheels. The claims made are to the using of two circular channels; the arrangement of the valves and pistons; the metal rings for packing, contained within grooves in the inner flanches, and the mode of pressing them up.

There is nothing new in this engine, either in the general construction, or in the particular points claimed. We could refer to engines essentially the same, in several published works treating on steam engines; but the worst feature of the affair is that neither of those which it resembles have answered in practice, whilst that now presented to us, does not appear to contain any redeeming point. It will be much more difficult to make than the ordinary engine, more difficult also to keep in order, and it will require considerably more steam to perform the same quantity of work.

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13. For an improved *Platform Balance;* Jesse Marden, city of Baltimore, September 9.

The whole claim made in this case is to "the manner of constructing the platform so as to project downwards for the purposes specified." "Now my improvement consists in forming a downward projection from the side pieces of the platform, by means of rings, or links, and staples, from the inner prongs of the fulcrum, by which the platform hangs perfectly free, and will play in any direction, as if it hung on chains or ropes, always finding its centre of gravity."

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14. For a mode of *Relieving the Shock in the Stopping of Rail Road Cars;* Charles Davenport, Cambridge, Middlesex county, Massachusetts, September 9.

Those who are well acquainted with the improvement in rail road cars, are aware that what has been called a buffing apparatus has been used to take off the shock occasioned by their coming into contact; the patent above named is obtained for a different mode of accomplishing this object, and also of affording a similar relief in starting. Instead of the continuous centre pole, by which the cars are connected, which receives the shock in stopping, and which takes the place of a perch in common carriages, there is a sliding box that projects out in the same manner, and is at its inner end connected to elliptical springs, like those used in carriages, placed transversely with the pole, and which are so fixed as to have the requisite play in either direction. Instead of these it is proposed to use spiral springs, fixed in the manner described in the specification. The claim is to the application of such springs.

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15. For an improvement in the *Dead Spindle*, used in spinning cotton. Henry G. Davis, Northborough, Worcester county, Massachusetts, September 9.

The following quotation will afford a general idea of the nature of the proposed improvement.

"My design being to relieve the spindle from the friction of the fly whirl, and the tremulous motion incident thereto, I make the whirl, and consequently the flyers, play upon a tube, called the friction axis, through which the spindle passes, instead of playing upon the spindle itself; as is now done in the spinning frames in use, and not of my invention. To accomplish this the tubes must be stationary, and of sufficient strength to sustain and keep regular and steady the motion of the flyers. I have attained this end by one casting of iron, which constitutes the tube, and affords the means of fastening it to the spinning bar, so called in spinning frames, in such way that the spindle passes through it, and when the whirl of the flyers is brought to its place it fits to the tube, and turns upon it as a perpendicular axis, instead of turning upon the spindle; the tube being a shell interposed between the spindle and the whirl.

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16. For a *Safety Hook, for detaching Tow Lines on Canals, &c.* Gotleib Schultz, city of Philadelphia.

This is merely a spring catch that may be opened by drawing upon a cord which disengages it, and allows the tow line to go clear. A similar contrivance it is proposed to affix to the swingle tree of a carriage. There is no claim, and but little room for one.

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17. For an improvement in *Rail Way Cars;* Anthony Sherman, city of Philadelphia, September 9.

The fore and hind wheels are to have separate frames, but they are to be connected by jointed, transverse coupling rods, in order to enable them to turn easily, and to adapt themselves to the curvature of the road. The axles are each to be divided in the middle, to allow an independent motion to each wheel, the axles are also to be enclosed within a safety tube, running along it, which will support it in case of breaking. The transverse rods, and the divided axles, have so often come under our notice that we have nothing further to say about them. They however, form prominent parts of the present claim.

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18. For *Eradicating Corns;* William Davis, Williamsburg, James City county, Virginia, September 9.

Diluted nitric acid is to be applied to the corns to soften them, and they are to be rubbed down with pummice stone; that is all. Nitric acid has often been applied to corns, and they have been rubbed down by files, or by emery sticks, made for the purpose; we apprehend, therefore, that those who have corns may still use the indicated means of cure.

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19. For an improvement in the *Coffee and Corn Mill;* Elijah Morse, and Caleb Putnam, Knoxville, Tennessee, September 9.

Nominal *improvements* are so easily made that it requires no talent whatever to be the author of them, and such is that which forms the subject of the present patent. The mill in which the pretended improvement is made, is the common cast iron mill with a conical shell and nut, in its unaltered state, excepting only that the patentees "claim as their own invention, and not previously known in the above machine, that the furrows in their mill run straight through, and not spiral, as in all other mills." It does not require two grains of mechanical knowledge to enable a person to decide that this change deteriorates instead of improves the mill; nor is it necessary to have dipped deeply into the logic of Aristotle, or of Watts, to arrive at the conclusion that it requires one and one to make two, yet in the case before us we are to admit that the inventive genius of two individuals might be put into requisition to devise one set of straight furrows.

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20. For a *Bedstead for the Sick;* Nathaniel Richardson, Boston, Massachusetts, September 9.

It would be a sheer waste of time to detain our readers with a particular description of this contrivance, which is intended only to elevate the upper or lower half of the frame and sacking bottom of a bedstead, by means of a windlass and cord. The mode of doing it is no improvement upon others, and the end obtained does not differ in the slightest degree from that often accomplished, and attainable by any mechanic in his own way. "The combination and arrangement of the parts" forms the stereotyped claim.

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21. For a *Saw Set;* Lewis Barmore, Hanover, Chataque county, New York, September 9.

The principal part of the specification of this patent consists in the exact measurement of the respective parts, and other matters of no moment. The setting is to be effected by placing the teeth of the saw upon a small anvil, and striking with a hammer, the handle of which passes through a shaft turning on gudgeons in uprights, the hammer being raised by the revolution of a piece of wire, bent crank fashion. The saw is to be sustained upon

a rest, and the points of the teeth are to bear against a metallic roller. The claims are to "the application of the crank to the hammer handle; the rollers to guide the teeth of the saw across the anvil, and the rest, block, and gauge, and their advantages," which latter appear to us to be few in number, as there are many saw sets in the Patent office which we should prefer to this last improvement.

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22. For *Stamps for Post Offices;* Benjamin Chambers, city of Washington, September 9.

These stamps are to have a fillet round the outer edge of the face, which fillet is cut, or left, on the solid metal. It surrounds, and is intended to protect, the letters which designate the office. The claim made is "the manner in which I construct the ledge, or projection on the outside circumference of the face of the block, being cut out in relief from the solid body of the cylindrical block."

We have seen such fillets, or ledges, cut out of solid blocks both of wood and metal, in use long before the obtaining of this patent.

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23. For *Supplying and Regulating the Draught of Air to Fire Places;* Robert Mayo, city of Washington, September 9.

Pipes, or tubes, of tin, or other material, which may be from one and a half to three inches in diameter, are to lead from the lower part of a building, up the outer walls, their upper ends opening under the grate or fire place. Such pipes may be added to buildings already erected; but in the erection of new ones it is proposed to form these ascending air channels within the thickness of the walls, their lower ends opening to the external air, and their inner to the fire place. Valves to regulate the quantity of air admitted, may be constructed of any suitable form.

The claims made are "*First.* The arrangement, combination of parts, and adaptation of the air pipes, or tubes, to ascend the outer walls or chimneys of buildings, or apartments, and penetrate the same contiguous to fire places. *Second.* I claim the construction of air channels or flues in the masonry of chimneys, or the walls of buildings, to ascend from a lower stratum of atmosphere and terminate near to, or in, the fire places."

With the exception of extending the tubes to the lower part of a building, it will not be pretended that there is any novelty in this contrivance, the practice of admitting air from without to feed fires, being old and common; but even the ascending tubes themselves are not new, they having been frequently recommended and applied to the supply of fires for the purpose of ventilating cellars, and other lower apartments; it may be said, however, in the present case, that this is not their object, that object being merely the supply of the fire; without inquiring into the validity of this allegation, it is proper to ask what are the advantages of these descending pipes, and we believe that this is a question which cannot be satisfactorily answered. The patentee says that we shall "thereby create a constant current through the tube, or pipe, of a strength proportionate to the height of the pipe, or the greater weight of the medium of atmosphere at the lower extremity, or inlet, than that at its upper extremity, or outlet; which takes place upon the same principle of pneumatic or atmospheric pressure, which forces water in a tube, or well, to rise to the height indicated by the known weight of the atmosphere: and this principle is equally applicable, of course, to the air channels, or flues, constructed in the masonry."

The foregoing may pass with the illiterate for good reasoning, but it is altogether false and unfounded. The pressure at the opening of the tube within the room will not be altered by the extra height of the atmosphere above the lower opening, the column within the tube being a perfect balance to this; the whole trouble and expense of the tubes may, therefore, be saved, together with the cost of a patent right to do that which is in itself altogether useless.

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24. For a *Saw Mill Gauge;* William A. Needham, Brimfield, Hampden county, Massachusetts, September 9.

This appears to be a very imperfect affair, when compared with many other devices for setting or gauging saw logs. A bar of iron is to be bent twice at right angles, thus, its ends being attached by hinge joints to the head block; upon the top bar there is to be a slide, which may be secured by screws, and which is to be graduated into inches and parts. The end of this bar towards the log has a piece attached to it, thus, ——————| which piece is to bear against the log, and to keep it upright. The claim is to "the arrangement of the parts described, to cause a log to be sawed into any required thickness marked upon the graduated edge of the slide."

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25. For a *Cooking Stove;* John Whiting, of Boston, and John Mears, of Dorchester, Norfolk county, Massachusetts, September 9.

The main, or only, novelty in this cooking stove, consists, like that of most others, in the particular arrangement of the respective parts, as devised by the patentees. The claim is to "the construction of such stoves, as aforesaid, and the several parts thereof, not separately, but in combination for the purposes aforesaid; and also the construction of stoves so that the hot air may pass first over, then down by the side of, and then under, the oven, and then between the oven, and the furnace, in manner aforesaid, and for purposes aforesaid. The construction of the oven and furnace may be somewhat varied, at discretion, and the side door for roasting may be dispensed with, if thought advisable; but the construction above mentioned is deemed most convenient, in all cases." We cannot attempt a description of the particular arrangement, which is well shown in the drawing, referred to throughout in the specification.

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26. For a *Coopers' Stock, Howel, and Croes;* Melancthon Sutton, Penfield, Monroe county, New York, September 9.

In this invention, the work heretofore requiring the use of two instruments, is to be performed by one. A very particular description of the tool is furnished, and explained by reference to the drawings, which show the peculiar form given to the cutting iron. The claim is to "the peculiar construction of the edge and angles of the cutting instrument, by which it supersedes the necessity of a separate howeling iron, and performs the work in less time. The moulding of the faced edge of the stock face, to conform to the cutting angles of said instrument; and the sliding gauge, as described, and delineated in the drawing."

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27. For a *Washing Machine;* James Lombard, Readfield, Kennebec county, Maine, September 9.

The trough of this machine is a concave semi-cylinder, closed at the ends,

and fluted along the semicircular part. The *rubber*, which is to act upon the clothes, is also a semi-cylinder, which passes into the trough, and is suspended by an axis at, or near, its centre. This rubber is either fluted, or covered with fluted rollers, passing from end to end on its curved surface. It is so hung, by means of a strap, or chain, as that it may recede from the trough, when too great a quantity of clothes may be between them, and also to admit of its continued pressure upon them. The rubber is to be made to vibrate by means of a handle. The claims are to "the form and application of the rubber, or interior cylinder. The mode of suspending and operating the rubber, and the application of the strap, or chain, whereby the pressure is regulated, and the rubber allowed to yield."

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28. For an improvement in the *Saw Mill;* Linus Yale, Utica, Oneida county, New York, September 11.

Upon the head block there is to be a plate of cast-iron, about three feet in length, which slides between grooves, or ledges, on a cast-iron bed, that is fastened to the block. A bar of iron, which may be an inch and a half square, is to be placed upon the slide, along that edge of it which is farthest from the log; by means of pins and holes, properly constructed, it may be placed firmly upon the slide, with either of its sides uppermost, and these four sides are divided and notched to suit four different thicknesses of stuff, the notches serving for a setting pall to fall into, which is acted on by a lever, which lever, when raised by the hand, sets the log. A similar slide, and its appurtenances, are affixed to the tail block, but here it is rendered self-setting by an apparatus, not very clearly described, and for the study of which we cannot afford much time. A particular construction of the dog is also described, but so obscurely that we know little, or nothing, about it, although it forms one of the matters claimed. Neither the use of the lever, nor of the slide containing the dog and bar, is claimed, but, "*first.* The dogs swinging upon a vertical shaft, as described. *Second.* The construction and use of the notched bar, as set forth. *Third.* The construction and use of the pointed, or setting, arm, as set forth. *Fourth.* The manner in which I construct the inclined plane, as set forth. *Fifth.* The manner of casting the plates and slides together."

The third and fourth claims refer to the self-setting part; the fifth at least, it might have been better to have omitted.

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29. For a *Machine for Breaking and Cultivating Sward Ground;* Guy Gray, Industry, Somerset county, Maine, September 18.

A square frame is made to contain a roller, like that used for rolling ground, and a tongue is attached to the frame to draw it by. The roller, as described, is four feet long, and is set with teeth in twelve rows, containing, alternately, five and six in a row; the teeth, which are pointed, are seven inches long, but curved so as not to project more than six inches from the roller. There are teeth, also, on the back rail of the frame, so set as to allow the roller to pass between them. The patentee says, that when this is "drawn over the closest sward land, it breaks it more thoroughly than any other machine known to him, so that the ground may be afterwards ploughed with less than half the strength of team otherwise required, whilst it is left in a much better state for cultivation."

There is not any claim made; the whole must, therefore, be considered as new, or the patent cannot be sustained.

30. For a *Loom for Weaving the Cloth for Stocks;* Conrad Kile, Erie, Erie county, Pennsylvania, September 18.

The frame, warp, and cloth beams, &c., are placed in the usual manner, the improvement consisting "in the form, or mode, of constructing them, and is grounded on the following requisite, to make the stock set closely to the neck, and accommodate itself to the shape, viz: that the selvage should be much longer than the centre of the cloth, so that, while the centre of the stock fits the neck closely, the selvage, both at top and bottom, is so loose as to yield easily to the motion of the chin, after the manner generally effected by inserting pieces of an angular shape around the top and bottom. This object of increasing the length of the selvage, I effect by means of the shape I give the beams above mentioned on their circumference, for, instead of their being straight from one end to the other, I form them concave, so proportioned that the girth of the centre of the beam is about one-third less than that of each end."

The particular arrangements necessary, or adopted, in completing the plan, are described at considerable length, and a claim is made to "the concave shape given to all the beams, and to the reed; to the manner of making the lower semicircular bar of the reed; and the manner of joining the uprights of the reed, by means of arms, to the axis of the straining beam."

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31. For a *Tailors' Measuring Apparatus;* John S. Rockafellow, Flemington, Huntingdon county, New Jersey, September 18.

The claim made is to "an improvement on D. Williams' patent, by the construction of a scale equal in length to the entire circumference of the human body, and having the tape of an entire length, and the movable slide and upright to secure a correct measurement for the cutting of garments."

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32. For an improvement in *Beds, Cots, and Hammocks;* William I. and Alfred E. Lyman, Easthampton, Hampshire county, Massachusetts, September 18.

The specification of this patent is more sentimental in its commendatory, than clear in its descriptive, part. It seems, however, that conical, spiral springs of wire, are to be interposed between the rails of a bedstead, and a frame above it, over which a covering of cloth, leather, &c., is to be stretched. For cots, &c., the fixtures must be adapted to them. In warm weather, a sheet only, and, at other seasons, a covering adapted thereto, will, we are told, "render this bed a great comfort to the sick, the weary, and the aged, and a great exciter to 'nature's sweet restorer, balmy sleep.' By the action and reaction of the springs, support is afforded to the inequalities of the human frame in equal measures, so that muscular action is in a sense suspended, and a quiet repose given to the whole system."

The patentees "claim as their own invention and improvement, the application of metallic conical spiral springs, as a support in the fabrication of beds, cots, or hammocks, in the manner herein described."

How many patents for the application of spiral springs we have seen recorded, we cannot tell, but they are not few. We, however, recollect one from the same county with the foregoing, dated August 25th, 1831, and noticed at p. 128, vol. ix., which, uninviting as we thought it, appeared to offer more comfort than the one under consideration.

33. For a *Plough for Cultivating Corn and Potatoes;* Peter Stahl, and John Diffenbacher, Turbut township, Northumberland county, Pennsylvania, September 18.

This instrument is made in the form of what is commonly called a cultivator, and is furnished with six shares, affixed to standards twenty inches in length, for the purpose of mounting the beams high up above the ground. For the particular form of the shares, the model is, incorrectly, referred to. The following is the claim.

"The shares, or mould-boards, which are each cast in one piece, and forming a coulter, share, and mould-board. The high standards, which carry the plough beams so far above the corn, or potatoes, as not to break it down so long as it needs cultivating. The placing these in such a manner as to plough, or cultivate, both sides of a single row of corn, or potatoes, at one and the same time of going over the same."

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34. For a *Wool and Flax Brusher;* William W. Calvert, Lowell, Middlesex county, Massachusetts, September 18.

"The principle by which this is distinguished from all other inventions, is the brushing of wool, or flax, by a bristle, or wire, brush, *into* teeth set on a cylinder, or otherwise, as may be convenient. And also the combination of the parts of the universal swiper, for which I claim a patent." The object in view is the separating the long and short fibres from each other. The machine is well represented in the drawings, and clearly described; without the former, however, we should fail in an attempt at the latter. We think that much ingenuity and skill are manifested in the mode adopted for carrying out the conceptions of the patentee, but we are unable to offer any opinion of the probable success of the plan, as it is, in the present instance especially, a question of experience.

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35. For *Printing and Dying Woolen Cloth;* William Duncan, Bellville, Essex county, New Jersey; an alien, who has resided two years in the United States; September 18.

If the person who has obtained this patent was employed in the woolen business in Great Britain, before his emigration to this country, we should not be able, with the utmost stretch of charity, to believe that he was unacquainted with the fact that the process he describes was generally known, and frequently used there. That we may not err in giving the process for which he obtains a patent, we will quote the precise words of the patentee himself.

"In order to preserve the native, or any other colour, for the purpose of ornaments in the printed article, from receiving the general, or ground colouring, which is given to it in dying the same, the ornamental figures are to be tied in knots, in such manner and form as the artist may think proper, by winding round them hemp, or thread, of any description, so as to resist the general colouring matter from penetrating into those figures."

We have known the process for more than half a century; among our earliest recollections are woolen garters, with mottoes on them, made by pressing against the strip of cloth, a mould, with letters cut on it, and thereby protecting the parts pressed in the process of dying. At the ends of these mottoes, and at other parts, were the flower-like ornaments made, in the way above described. But, apart from this, there are few dealers in cloth, anywhere, who are not well acquainted with this process, as it is

common as a test mark on the corners of pieces of cloth, to show that the colour given has been produced at two operations. Who has not observed these stars, or rosettes?

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36. For a *Machine for Planting Cotton;* Robert S. Goodman, Ballsville, Powhatan county, Virginia, September 18.

This is one of those classes of machines, the individuals of which can scarcely fail of exhibiting a strong resemblance to each other. They run upon wheels, which are fixed on a revolving shaft, or axle; they carry a hopper, into which the seed is put, and which falls through an aperture regulated by the revolving axle. There is a share in front of the machine, to open a furrow, and a scraper behind, to cover the seed. These are the general elements, which are common to all, and are common property; what is left, therefore, to ingenuity, or fancy, is to devise those minor arrangements upon which the more or less perfect action of the machine is dependent, and which have usually too little of originality, or skill, to render it worth while to follow them out, and such we think the case in the present instance. The claims are to "the manner of using the wheel at the perforation at the bottom of the hopper. The revolving shaft, with the pin, or pins, and conductors, attached to it, to be set in motion in the manner described."

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37. For a *Machine for Shelling Corn;* James S. Harris, Poultney, Rutland county, Vermont, September 18.

We apprehend that this will prove to be one of the least valuable of all the corn shelling machines, from its being inconvenient and laborious to operate with, whilst it will not be recommended by its efficiency. It consists of a fixed rubbing board, set with teeth, or otherwise furnished with projecting points, and a movable rubbing board, to be worked up and down by a lever, which is moved by the right, whilst the feeding is to be performed by the left hand. No other provisions are spoken of, nor is any claim made.

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38. For a machine for *Setting Boxes in Hubs;* Edward Badlam, Jr., Chester, Windsor county, Vermont, September 18.

The hub is to be fixed on a frame, being adjusted by screws, so that it shall be properly centred. A shaft, fitted into collars, and turned by a winch, carries the cutters which are to let in the box, which cutters are made adjustable, in order to adapt them to the required size. The claim is to "the arrangement of the slides, dies, screws, and scales, for the purpose of adapting the machine to all sizes of hubs, and to enable the workman to set the hub in the centre of the frame."

There are several patented machines for the same purpose, arranged in a very similar way, and possessing all the virtues of the foregoing.

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39. For *Propelling Time-pieces by the Expansion and Contraction of Atmospheric Air;* Andrew Morse, Jr., Bloomfield, Somerset county, Maine, September 18.

How many such machines as that here patented have been made, it would be impossible to tell, as they are calculated merely to satisfy the curiosity of their contrivers, and destined to final repose in the lumber room. An instrument very similar to that before us, is noticed at p. 126 , vol. v. of

this Journal, and some remarks upon the application of the principle of expansion and contraction by change of temperature, may be found in vol. 2. p. 326. The air which is to operate, is to be contained in a cylindrical vessel, within which there is to be a second cylinder, open at top, but closed at the bottom by a sheet of India rubber, or other flexible, air-tight material. As the air alters in its dimension by heat, it is to raise and lower a piston, working loosely in the inner cylinder, and resting on the India rubber; a rod from this piston turns ratchet wheels, and winds the clock. The claim is to "the before described machine for winding up time-pieces, with the arrangement and adaptation of its several parts." Were the thing of any value, it might be a matter for regret that the description and claim were not less vulnerable than they are; but we think them as good as the invention, and do not anticipate the validity of the contrivance being made a question in court.

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40. For a *Machine for Dressing Hoops;* B. Kimball, A. Pevey, and F. Spalding, Petersborough, Hillsborough county, New Hampshire, September 18.

A wheel furnished with cutters on its face, near to its periphery, is made to revolve by means of a mandrel, like that of a lathe. A gauge stands in front of the cutters, having a roller, against which the outside of the split bears; this gauge is capable of being made to recede, by means of a lever, so as to allow the necessary increase of thickness in case of knots, &c. The following is the claim. After stating the various modes of arrangement which may be adopted, the patentees say: "We do not, therefore, claim the individual parts of this machine, as they have all been used under other combinations, and for various other purposes; but what we do claim as our invention, is the construction of an instrument for dressing hoops, made and operating, substantially, in the manner herein set forth; having a revolving cutter wheel, a shifting gauge, and the auxiliary appendages which give to it that character by which it is distinguished from other machines for the same purpose."

This machine has, we are informed, been found of very great value in its application to the purpose for which it was constructed.

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41. For a *Cradling and Mowing Machine;* Edward Badlam, Jr., Chester, Windsor county, Vermont, September 18.

By means of a face cog wheel on the inside of one of the wheels upon which the machine runs, motion is given to a horizontal shaft, the opposite end of which gears into a bevilled pinion on a vertical shaft, which sustains scythes, revolving horizontally. Small wheels on the underside of the fixtures of these scythes, run upon the ground, and serve to raise them over knolls, whilst springs above them keep them in their places; the grass, or grain, is received upon fingers, which conduct to a rack.

The claim is to "the springs, with the fixtures for enabling the scythes to pass over small knolls; the fingers and the rack, for the purpose of catching and laying the grass and grain, after being cut by the scythes."

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42. For machinery for *Cutting and Collecting the Heads of Grain, and Grasses;* Jacob Peck, and Daniel Ashmore, Jefferson county, Tennessee, September 18.

This machine is intended to be driven forward like a wheelbarrow, when

grass seeds are to be collected, but for collecting the heads of grain, horses are to be employed to *drive* the apparatus, which, in its general form, resembles a cart. The machine must be mounted upon wheels of such height as will suit the grain, or grass, the seeds of which are to be collected. The heads, as the machine advances, are to be received between a row of lancet shaped knives, flat on the top, and beviled to a sharp edge from below. Fingers of wood, or of metal, may also project forward, the better to guide the heads to the knives. Above the knives there is a kind of revolving reel, set in motion by bands and whirls, connected with the running wheels of the carriage; this reel, or open cylinder, carries knives, which come nearly into contact with the row of fixed knives before spoken of, which cut off the heads of the grain, or the grass. There are various appendages to, and modifications of, this machine, described in the specification, which we cannot wait to notice.

"What we claim as our invention, are the lanceolate knives, or, in the stead of them, the series of fingers, with other knives, to steady the grain in cutting. The revolving wheel, with strikers, knives, and canvass. The collecting hand with its wheels, crank, lever, rest, and adjustment. The pulleys and band to drive the revolving wheel. The propelling power behind. The principle of the governer of the rudder to give direction to the machine; and the application of the whole to the use and purpose of cutting and collecting the heads of grain, leaving the straw on the ground, and in like manner saving clover and other grass seed."

We believe that it will be proved upon investigation that this claim embraces too many particulars, and thus includes things which have been before well known and employed. Rows of lanceolate knives are not new; the propelling from behind in grass and grain machines is not new; the driving a wheel by a band and whirls is not by any means a fit subject for a claim; yet there is certainly enough in the machine upon which to have procured a valid patent.

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43. For an improvement in the manner of *Dressing Mill Stones;* David B. Napier, Casey county, Kentucky, September 18.

In a stone four feet in diameter, a circle of eight inches is to be described at the centre, and eight leading furrows are laid off, each of which forms a tangent to said circle, which gives the leading furrows four inches draught. Two short furrows are laid out between each of the leading furrows, the strip being still laid to the periphery of the draught circle; these latter terminate $1\frac{1}{2}$ inch before they reach the leading furrows. The leading furrows are to be half an inch deep, and from one to one and three-fourths of an inch wide. The short furrows are one inch wide.

"The only right I claim is in graduating the long or leading furrows so as to receive the feed freely; and the draught of the short furrows so as to make them pass over each other at an angle of about 25 or 30 degrees."

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44. For an improvement in the *Saw Mill Carriage;* Samuel Phelps, Mount Morris, Livingston county, New York, September 18.

This patent is taken for a very simple, yet, we think, a very efficacious and good mode of running back a saw mill carriage. The ways upon which it runs are to be furnished with friction rollers, and to be so inclined that the carriage will run back by its own gravity. An elevation of three or four inches in twenty feet is found to be sufficient for this purpose, when the

friction rollers are well made. The claim is to the mode of running back a saw mill carriage.

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45. For *Propelling Boats;* John L. Smith, Charleston, South Carolina, September 18.

This invention will not make a revolution in the art of propelling boats. The propeller is to be a screw, or some equivalent instrument; a cavity to receive this screw, is to be made by giving to the boat the form of a twin boat from about midships to the stern; the fore part, to the bow, being in the ordinary shape. The patentee calculates that this cavtiy will be filled with nearly still water, and that he will thence derive very great advantages, as will be seen by the following claim.

"What I claim as my own invention, and not heretofore used, in the above described improvement, is the peculiar devise by which I obtain the management of the body of comparatively still water, and the application of my propelling power therein, as has been already stated; or in other words, the manner of propelling boats or other bodies by means of screws, or other propellers, working in the dead or still water, obtained by such a construction of the vessel as shall leave a cavity, or cavities, or hollow space therein, open only to such a distance, and at such a point, or points, as may be deemed most advisable the screw, or other propellers, should be placed in."

The screw has been tried often enough to prove that it is one of the most inefficient propelling instruments which have been essayed, and it may be safely predicted that the cavity in which the present patentee proposes to place it will not aid in redeeming its character.

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46. For *Manufacturing Glue;* Jonathan Morgan, Portland, Cumberland county, Maine, September 18.

This patent is taken for improvements in the apparatus employed in making glue, and in the mode of using it; the specification, describing these improvements, is one of very great length; and even the claims alone are too extensive for us to present to our readers. They relate to the construction of the boiler, with the application of steam to it. The construction of the netting frames on which the stock is suspended; a peculiar manner of making the pans employed; and also a washer wheel for cleansing the stock.

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47. For a *Cooking Stove;* Ezekiel Daball, North Canaan, Litchfield county, Connecticut, September 26.

The claims to this stove refer to the particular manner in which the parts of it are arranged, and contain all we think it necessary to give; they are the following.

"Those parts of this stove which I claim as my own invention are the following: the fixed horizontal plate over the fire, containing two orifices, corresponding in size and position to the two orifices in the top plate, together with the two swing dampers over that plate; another damper which shuts the space between said fixed plate and the oven; and also the two swing dampers between the top plates of the stove and the top plate of the oven; also the rim and two movable plates forming the top of the stove, and the invention described for changing the place of the movable plates; also the smaller pipe open at both ends, passing through the common stove

pipe, and the ventilation for carrying off the steam. These things I claim as my invention, and for them only do I claim letters patent of the United States."

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48. For *Cleansing Clover and other Grass Seeds;* Hiram Holt, Weld, Oxford county, Maine, September 27.

A cylinder, which may be two feet long, and the same in diameter, is to be covered with sheet iron, pierced so as to constitute a grater. Two concave shells, with like surfaces, are to be placed one on each side of this cylinder, leaving an opening at top for feeding, and at bottom for the escape of the seed. The cylinder, whose axis is horizontal, is to be made to vibrate backward and forward, to rub out the seed. The concaves are adjustable by screws. The claim is to this particular action of the cylinder, furnished with a concave on each side.

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49. For a *Machine for Turning Boots;* Sherburn C. Blodget, and Henry Boynton, Rowley, Essex county, Massachusetts, September 26.

This machine is for turning boot-legs, and the patentees claim the whole arrangement of it, which, they say, effects, with great facility and ease, what has hitherto been a troublesome operation.

A tube of tin, eight inches long, and four in diameter, is to be placed so as to stand vertically upon a suitable frame. The top and bottom of the tube are to be left open, the top having its edge smoothly turned over a wire, and the bottom being firmly attached to a perforated board, forming the top of the frame. The boot to be turned is placed over the tube, and two hooks, attached to a rod which passes up through the tube, are made to lay hold of the straps of the boot; the lower end of this rod is formed like a stirrup, and on pressing this down by the foot, the boot is drawn through the tube, and turned, the hands of the operator aiding in the process.

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50. For a *Cooking Stove;* Putnam Page, Sangerfield, Oneida county, New York, (assignee of D. Gage,) September 26.

It is stated in the specification that this patent is obtained for an improvement on what is called the *Bool* stove; and the said improvement consists mainly, if not entirely, in changing the dimensions of the fireplace, the oven, and certain other parts. There is not any thing which can properly be called a claim, but we are told that "the entire object of the improvement is, first, to forward the speed and conveniency in cooking and washing, and other business; secondly, to save a great proportion of the fuel usually taken and required in other stoves; thirdly, its durability, each piece being so shaped and constructed as not to be broken or cracked by the use of the fire."

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51. For a *Forge Back;* James Knickerbacker, Laporte, Laporte county, Indiana, September 26.

This forge back is to be of cast-iron, with a cast-iron box at the back of it, to receive the air from the bellows; there are to be two or more tuyeres, or tew irons, to admit air into the fire, and these are to be furnished with valves, or stoppers, attached to rods which pass through the back of the box, so that they may be opened or closed at pleasure. The advantages which result from the use of a box are descanted upon as though this were a novelty, whilst the only new feature in this contrivance is the using more than

one tuyere, a thing of very doubtful utility in a common smiths' forge. The claim is to "the before described apparatus, and mode of regulating the blast of forges; but I make no claim to making the forge back and bottom of cast-iron." This claim is too broad, as the *apparatus*, with the exception named, is old.

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52. For an *Alarm for Steam Boilers;* Thomas Odiorne, Malden, Middlesex county, Massachusetts, September 26.

The specification says, "this is done by means of a tube extending from without to the inside of the boiler, through a fixed standard erect within, and through the sides or ends of said boiler, as the case may require, to which standard is attached a lever valve, closed by a spring, and opened by a sliding buoy, which as it settles down upon the falling surface of the water, presses upon the lever, opening the valve, when the escaping steam gives the alarm. This may be done by a racket wheel, by a buzz, by a bell, or by a trumpet, &c. The whole of this apparatus as applied and exemplified in my draught and *model*, I claim."

As regards the *model*, we do not refer to it for our own information, as it makes no part of the patent; the description is very general, and the drawing does not supply its deficiencies. The idea of giving an alarm by the subsidence of the water is a very familiar one; the mode proposed is not, we think, founded upon correct principles, as, in practice, a buoy that is to rise and fall, peaceably and quietly in the boiler, will not always do so.

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53. For an improvement in the *Chimney and Fire Place;* Moses Perin, Connersville, Fayette county, Indiana, September 26.

This appears to us to be a very strange kind of contrivance, and one which few persons are likely to adopt; it is not very clearly described, but sufficiently so to show that there is to be a kind of blower, or register, to regulate the draught; and, in front of the fire place, two or more sliding doors to close it up either entirely, or partially. "The combination of the parts, and the mode of putting them together," constitute the claim.

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54. For an improvement in the *Grist Mill;* Owen Moses, Malone, Franklin county, New York, September 26.

The stones in this mill are to run vertically, and are both of them to revolve, but in opposite directions. The shaft of one stone is to be a hollow tube, through which that of the other passes, and a horizontal crown wheel is to mash into wheels on each of these shafts. The feeding is to be through the eye of one of the stones. There is no claim, and if it is supposed that the revolving of both stones, or the mode of gearing to effect this, is new; a little inquiry would manifest the erroneousness of such an opinion.

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55. For a *Spiral Cone Blower;* Benjamin Brundred, Oldham, Bergen county, New Jersey, September 26.

This is a revolving blower, acting upon the principle, but differing in form from, the ordinary winged blower. The casing is to be conical, with a shaft passing through its axis, upon which shaft there are to be wings set spirally. The air is to be admitted at the smaller, truncated, end of the cone, and is to escape through a tube, or tubes, at its lower end. The patentee tells us that 'the great advantage of the spiral blower, over all other blowing machines now in use, consists in its spiral or screw like wings, revolving

with great velocity inside of the casing, and accurately set and curved so as to draw in and force forward the air."

No directions are given respecting the accurate setting and curving of the wings, and in the specification it is indicated that they may be straight. The thing may be good, but we do not see the source of its excellence. There is no claim made.

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56. For a *Washing Machine;* John J. and Ebenezer C. Milliken, Winthrop, Kennebec county, Maine, September 26.

A trough is to be made in which there are to be two sets of vibrating stocks, of the ordinary form; a double crank shaft, the cranks at right angles with each other, is to work the levers by which the stocks are suspended; the cranks pass through slots in these levers, and are furnished with friction rollers, thus dispensing with pit-men, but by a much worse contrivance.

Claim.—"The application of a crank directly to the arms of the stock, in such a manner that one stock only shall press at a time. The application of friction rollers to the crank, as above described, &c.

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57. For an improvement in the *Composition of Mead;* Theodore T. Kimball, and Adner H. White, Dedham, Norfolk county, Massachuetts, September 26.

One pint of sugar-house molasses, two table spoonsfuil of wheat flour, one pint of new milk, and one pint of yeast, are to be put into a six gallon cask; air is then to be forced in by a force pump, and the cask stopped for twenty-four hours. At the expiration of this time, two gallons of boiling water, mixed with five pints of honey, or five pounds of loaf sugar, one third of an ounce of ginger, half an ounce of allspice; two ounces of essence of sassafras, a tea spoonful of essence of rose, and half an ounce of isinglass, are added, and the cask filled up with cold water. It is then to be corked up, and allowed to remain for twelve hours, and it is ready for use.

The claim is to "the use and application of the honey, or loaf sugar, the sassafras, the rose, and the isinglass; and the proportions of the last described composition."

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58. For *Supplying Air to Forges;* Seth W. Watson, and Cloud Robinson, Ashtabula, Ashtabula county, Ohio, September 26.

This contrivance is in part like that described at No. 51; that is the tuyeres are to be supplied with stoppers in the same way; but instead of one box only, there are to be two, connected by a tube, so that the air blown into one may pass freely into the other; the fire is to be between these two boxes, each having its blow pipe, or tuyere. The claim is to "the carrying the air to the second from the first box, so as to let the air to the fire in counter currents, and in opposite directions, from the same bellows."

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59. For an improvement in the *Art of Finance;* John Golder, city of Philadelphia, September 26. (See specification.)

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60. For *Weaving Silk by the Power Loom;* Gamaliel Gay, Poughkeepsie, Dutchess county, New York, September 26.

This patent is obtained for "an improvement in the art of manufacturing silk;" which improvement consists in performing the operation of weaving in the power loom, to which purpose, it is said, that instrument has not here-

tofore been applied. The machinery is not claimed, as it is employed in the usual form, and only adapted to the weaving of silk.

A question has arisen whether such a patent is valid, and for its support reliance is placed upon that provision of the patent law allowing a patent for "a new improvement on any art." If silk can be woven upon the power loom with much greater economy than by any method previously adopted, it is contended that this constitutes such an improvement.

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61. For *Condensed or Concentrated Writing Ink;* John D. Myers, city of New York, September 26.

The claim made is to "the making of inks into a solid substance capable of being moulded into cakes, rolls, balls, wafers, pills; or the above substance reduced to a powder, or any other shape that may be desired, free from sediment, and fit for instant use by the application of warm or cold water."

The recipe given is very imperfect, mentioning only one of the ingredients of ink, and is as follows. "A watery extract is made from nut galls, &c. or any other matter suited for making black or coloured inks; thus forming a common writing ink. The whole is then filtered and carefully evaporated, by steam or other heat." Qu. May a person add water to dried up ink?

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62. For *Turning Short Curves on Rail Roads;* James Stimpson, Civil Engineer, Baltimore, Maryland. First patented August 23d, 1831. Patent surrendered and reissued, September 26. (See specification.)

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63. For the *Formation of Rail Road Plates for turning Curves;* James Stimpson, Civil Engineer, Baltimore, Maryland. First patented August 23d, 1831. Surrendered and reissued, September 26.

This patent might have merged in the foregoing, the specification of which we have given, but as the subject was divided into two parts originally, it has been thought best not to incorporate them in the reissue. The specification before us enters very much into details, and is too long for our pages, and as it cannot very well be epitomized, we shall give the claim only.

"What I claim as my inventions or improvements are, the employment of plates, or rails, either of cast or wrought iron, constructed upon the principle, or in the manner described, having narrow grooves for the flanches to run in, by which they are perfectly adapted to the unobstructed passing of all kinds of carriages used in streets, over them. The running of the peripheries of the flanches, or of the cone, or rise on the tread of the wheel, upon the rail, in the manner and for the purposes set forth. And the employment of plates of cast iron, upon the principle described, for the crossing of gutters, and the turning of curves."

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64. For a machine for *Shaving Shingles and Staves;* William H. Wilkinson, Wayne, Warren county, Ohio, September 26.

The articles to be shaved are to be forced over irons, fixed as plane irons, on the face of a bench. Two vertical wheels, acted upon in a way described, and shown in the drawing, serve to carry the articles over the irons. There is nothing in the machine worthy of special notice. The claim is to "the arrangement of the wheels acting upon the driver."

65. For improvements in the *Wheels and Machinery of a Saw Mill;* John Muir, Menallen, Fayette county, Pennsylvania, Sept. 26.

There are to be two wheels which are to be acted upon by the water in succession, the first a small flutter wheel, the second a larger one. They are to be geared together by wheels upon their gudgeons, and an intermediate shaft; the claim is to "the addition of the large water wheel and chute, and the gearing which connects the two."

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66. For an improvement on his *Bedstead,* patented March 31st, 1834; Perry Prettyman, Georgetown, Sussex county, Delaware, September 26.

Our notice of the patent above alluded to will be found at p. 261, Vol. 14. The difference now made is but small, and as we fully described the original plan, we shall now give the claim only from the new patent, which is to "the pins across the mortises of the posts, and the pins through the rails and catches."

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67. For a *Mortising Machine;* Charles Gates, Antrim, Hillsborough county, New Hampshire, September 26.

The claim made in the case of the above named machine, is to "the manner of arranging the several parts on to a common bench, so that they may be removed from the upper part thereof whenever they are not wanted, and returned at pleasure." It will be seen by this claim that there is nothing special in the operating parts of the apparatus.

Specifications of American Patents.

Specification of a Patent for a Machine for spreading India Rubber upon cloth. Granted to William Atkinson, *Lowell, Massachusetts, August* 15, 1835.

To all whom it may concern, be it known, that I William Atkinson, of Lowell, in the county of Middlesex, and State of Massachusetts, have invented an improved machine for the purpose of spreading caoutchouc, or India rubber, in solution, upon cloth, or other material, and of drying the same by steam, and I do hereby declare that the following is a full and exact description thereof.

The cloth to be coated with India rubber is to be made into an endless web, by sewing its two ends together; and other articles, such as skins of leather, may be coated therewith by spreading them on, and affixing them to, an endless web so made. This web is passed around cylinders which are made to revolve, and the dissolved caoutchouc or India rubber, is spread upon the endless web by the aid of a third cylinder, placed parallel to, and nearly in contact with, one of the cylinders around which the endless web passes.

The dimensions of the machine may, of course, vary, according to the width and length of the material to be coated or covered. In designating certain sizes and proportions of the respective parts, therefore, I do so only for the purpose of facility in description, and of indicating what has been found to answer well in practice.

I make a frame of wood, which may be sixteen feet long, and three feet six inches wide, the bottom timbers being sufficiently stout to support the carriage, and other parts, to be presently described. Into the ground

sills, or lower part of this frame, uprights are mortised, which serve to support a rail on each side, which may be three feet four inches from the floor, leaving, however, the sills sufficiently clear within the uprights to form a rail way upon which the rollers of a carriage may traverse back and forth.

Upon suitable supports, at one end of this frame, there are placed two cylinders of metal, usually of cast-iron, each of them one foot in diameter, and two feet nine inches long. The axes of these cylinders are in the same horizontal plane, and parallel to each other; around the inner cylinder the web to be coated passes; and the outer cylinder is made adjustable by means of screws, or otherwise, so that it may be brought into contact with, or removed to any required distance from, the web, or cloth. These cylinders are geared together by means of toothed wheels upon their shafts, cut sufficiently deep to admit of the requisite adjustment. The shaft of a pinion by which they are driven has on it a fast and a loose pully; when revolving they turn inwards.

The second, or carriage cylinder around which the endless web passes, is supported upon a carriage, furnished with wheels, or rollers, which run upon the lower rails, or sills. This cylinder is also to be made of metal, and when used as a drying cylinder, it should be large in diameter, say three feet. A windlass is placed at the back end of the frame, from which ropes pass to the cylinder carriage, serving, by means of a winch ,to draw the carriage, so as to render the cloth taut. Steam is to be admitted into the cylinder through a hollow gudgeon. For this purpose a steam tube is attached to the gudgeon, its other end passing through a stuffing box in a larger tube, attached to a boiler, thus admitting of the requisite motion of the carriage.

In order to apply the solution of India rubber to the cloth, &c., and to confine it to the proper width, we fit two cheeks, or pieces of wood or metal, so as to rest upon the two contiguous rollers, one at or near each of their ends, and these, when in their places, convert the rollers into a trough, or hopper, for containing the solution. The distance of these pieces from each other is regulated by attaching them together by means of a frame, or rod, at their upper sides, so that they may slide, and be affixed in their places by thumb screws, or otherwise.

When spreading the rubber on the cloth it is necessary to prevent its adhering to the outer roller, and this, among other methods, may be effected, by means of wet sponges, or brushes, laid along it, or by keeping it wet in any other way.

I intend sometimes to use the drying and the spreading apparatus detached from each other, in which case but two rollers, of any convenient size, will be employed in the drying process, and steam may then be introduced into each of them. I intend also, sometimes, instead of the large drying cylinder above described, to cause the cloth to pass over a stationary metallic box, or steam case, in its passage from the spreading to the straining or carriage roller, making tbe upper surface of this case convex, that the cloth may be kept in close contact with it; the space between the two sides of such box, or case, need not be more than from one to two inches.

What I claim as my invention, and for which I ask letters patent, in the above described apparatus, is a machine for spreading India rubber upon cloth constructed, and operating, substantially, in the manner of that herein set forth. I do not claim the mere spreading of the substance by means of cylinders, this having been previously done, but we do claim the employment of two cylinders for the purpose, connected together, and made to con-

cur, in producing this effect, acting upon the principles described. I also claim the general arrangement and application of the apparatus, for the drying of the solution by means of steam, either in combination with, or separate from, the spreading apparatus, as I contemplate the using of them either conjointly or separately, as hereinbefore set forth. I do not claim drying cylinders, or boxes, heated by steam, as my invention or discovery, but the combination and application thereof in the way, and for the purpose by me herein fully made known.

Specification of a Patent for an improvement in the manner of preparing and leaching Ashes, and manufacturing Potash. Granted to ELIJAH WILLIAMS, *Harbour Creek, Erie county, Pennsylvania, August 15th*, 1835.

To all to whom these presents shall come—greeting,—Be it known, that I, Elijah Williams, of Harbour Creek, Erie county, State of Pennsylvania, have discovered and invented an improvement in preparing and leaching ashes and making Potash, and that the following is a full and exact description of the same, namely. The said improvement consists of two parts.

First. Burning over crude ashes in a large body, by building fires under, in, or on them, which will in a few days burn the coal and most other impurities out of them. They are then in a running hot state, and in this manner they are boiled in pure water, or weak lye, about fifteen minutes with a brisk fire, using about equal proportions of water and ashes; then add unslacked lime, in the proportion of about one bushel of lime to ten or twelve bushels of ashes. Boil a few minutes longer, and let it off in the leach during the effervescence.

Second. The boiled ashes are to be put in leaches from six to eight inches in depth, and boiling water applied until the strength is out of them; the ley is then boiled and melted down in the usual manner, this method produces a beautiful white article yielding from ten to fifteen per cent. more pure alkali than the best samples of commercial potash, manufactured upon any plan heretofore known, as I believe.

Lime has heretofore been used in many ways in the manufacture of potash, but the inventor claims that the plan of burning over, and boiling the hot ashes, and the unslacked lime and letting them into the leach during the effervescence, as before described, was discovered by him, and is the chemical process on which he depends: he also claims that he did invent the hereinafter described machinery for the purpose of manufacturing ashes. The boiler used for boiling ashes, or ley, should be made of sheet-iron, or copper, on the following construction. With a flat bottom, about three feet six inches in width, about seven feet in length from twelve to sixteen inches deep, with a tube in the side, or end, for the purpose of letting off the contents—the size of said boiler may be increased and diminished, and it is to be set in an arch for use; the leaching trough should be about twenty feet long, two and a half feet wide, and twelve or fourteen inches deep, with a flat bottom, having a lime strainer fixed about two inches above the bottom, and a tube below the strainer, for the purpose of letting off the ley.

Directions.—The boiler being set in an arch for use, put in of burned over hot ashes, about ten bushels, with as many bushels of water, or weak ley, boil with a brisk fire about fifteen minutes, then put in one bushel of unslacked lime, boil about as much longer if it does not go over, then let it

off into the leaching trough during the effervescence. A greater or less charge may be put in according to the size of the boiler and leaching trough. Have the boiled ashes from six to eight inches in depth in the leaches; then first put on weak ley, hot if you have it, after which continue with hot water until the strength is off, boil the ley, and melt down in the usual manner.

Clear ashes may be worked, (if not hot) by using more lime and boiling longer, but not to so good effect.

ELIJAH WILLIAMS.

Remarks by the Editor.—The practice of reburning the ashes was adopted, and proceeded in for a considerable length of time, more than forty years ago; and it was at first imagined that the amount of potash was thereby considerably increased. It was at length discovered, however, that the bulk was considerably reduced by the reburning, and that the apparent increase was principally due to this circumstance; the small increase produced by reducing the coal to ashes did not nearly compensate for the expense and labour of burning, and the plan was abandoned. We apprehend that the increased production spoken of by the patentee will be found to arise from the cause above stated.

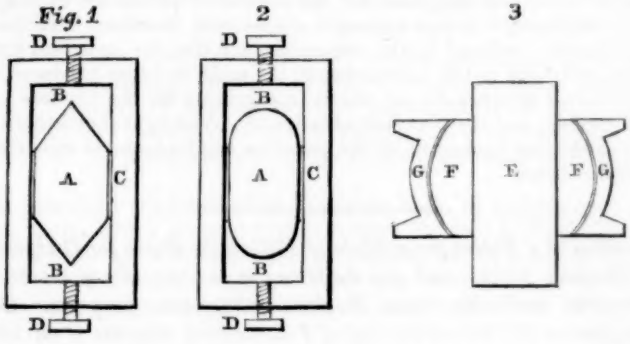
Specification of a Patent for a Mode of Fitting the Boxes for Gudgeons into the Plummer Blocks; and also the fitting of the Bearing of the Slides for Locomotive and other Steam Engines, and for other purposes. Granted to MATTHIAS W. BALDWIN, *city of Philadelphia, August 17th,* 1835.

To all whom it may concern, be it known, that I, Matthias W. Baldwin, machinist, of the city of Philadelphia, in the state of Pennsylvania, have invented a new and improved mode of fitting the boxes within which gudgeons are to run, into plummer blocks, and also of fitting and adjusting the bearings of slides, or guides, for piston rods; which inventions are applicable to locomotive engines, and also to other purposes. And I do hereby declare that the following is a full and exact description thereof.

The boxes in which the gudgeons used about locomotive and other steam engines, and machinery of various kinds, are received, and turn, have heretofore been fitted into the plummer blocks, or pedestals, made to receive them, by filing, or other analogous means, their ends being made either square, or angular, and adapted to corresponding parts in the plummer block, or pedestal, prepared to receive them. My improved mode of fitting them consists in turning or boring the opening, or seat in the plummer block, into which the boxes are to be fitted, so as to make each of the cheeks cylindrical segments. The boxes in which the gudgeon is to run, are then to be attached to each other by screws, or otherwise, and turned by means of a slide rest, or worked in any other manner, so as to make their ends cylindrical, and to cause them to fit exactly to the cylindrical cheeks, prepared for their reception, in the plummer block.

In constructing the slides for the pistons of locomotive and other steam engines, and for other purposes, the slide bar has usually been made square, or four sided, and its angles usually right angles; and the brasses, or bearings, contained in the box within which it slides, have been adjusted to it by set screws operating upon three sides thereof. In my improved mode of construction, the adjustment is made to operate upon two sides, or edges, only. For this purpose, I make my slide bar flat on two sides, and the

other two sides, or edges, half round, or otherwise form them into two planes, meeting each other along the middle thereof, by which means the rod will become six sided, this latter form being preferred to the rounding of the edges. The box within which the bar slides, is provided with two brasses, or bearing pieces, with hollows, or grooves, in them, adapted to the edges of the sliding bar, and fitting accurately between the parallel sides of the box; when, therefore, the brasses, or bearings, are adjusted to the edges of the rod by set screws acting against them, the rod is embraced by them so as effectually to check all tendency to a lateral motion, as will appear by an inspection of the drawings deposited in the Patent Office.



Figs. 1 and 2, cross sections of the box and slide bar, with angular and with circular fittings.

A, slide bar.

B, brasses, or bearings.

C, boxes.

D, adjusting screws.

Fig. 3, horizontal section of a plummer block and boxes, through the centre of the gudgeon.

E, gudgeon.

F, box.

G, cheeks of the plummer block.

What I claim as my invention, and wish to secure by letters patent, is the mode of fitting the boxes of gudgeons into plummer blocks, pedestals, or other receptacles, by boring, turning, or otherwise, so as to make the fittings cylindrical. I also claim the fitting of the slides for the pistons of locomotive engines, and for other purposes, into brasses, or boxes, adjusted and operating in the manner hereinbefore set forth.

MATTHIAS W. BALDWIN.

Specification of a Patent for a mode of destroying Weevils, in Grain; to expel moisture from grain, meal, and manufactured flour, and for drying malt. Granted to JAMES A. LEE, *Administrator of James Lee, deceased, Maysville, Mason county, Kentucky, August* 17th, 1835.

To all to whom these presents shall come: Be it known, that James Lee, deceased, of the town of Vevay, in the county of Switzerland, and State

of Indiana, in his life-time, invented a new and useful improvement for destroying weevils and other insects and their eggs, in grain, meal, and manufactured flour, and for drying malt, and that the following is a full and clear description of the same, as invented or improved by him.

This improvement consists of one, or more, hollow cylinders, or prisms, made of sheet-iron, or other metal, of any required dimensions in diameter or length. Fixed on an angle in an inclining position, in the manner of a bolting-reel as is used in mills for bolting flour; it is enclosed in an oven or arched room, made of brick, stone, or other material, sufficiently wide to contain one or more cylinders, or prisms, aside of each other, and of height sufficient to admit of one or more stoves, or flues, calculated to communicate to the cylinders, or prisms, the quantity of heat required for destroying the living insects and their eggs in the grain, and for thoroughly expelling the moisture from the grain, malt, meal, or manufactured flour; the cylinders, or prisms can be moved either by hand, or machinery; the grain, malt, meal, or flour, is introduced through a hopper at the upper end of the cylinder, or prism, and by its inclining position and revolutions it is carried to the lower end, where it is discharged; in its passage down, the grain and malt is kept rolling, the meal and flour is constantly kept in a floating, pulverized state, not subject to concretion, or coagulation, and to prevent the meal, &c. from adhering to the cylinder, or prism, and being subject to be burnt, I fix several combs on the surface of the cylinder, to raise strikers of sufficient weight or force, to jar the cylinder, so as to disengage the meal, or flour, that may adhere to it.

By the process in this improvement the living weevils, or other insects, will be killed, and their eggs destroyed: the moisture in the grain, malt, or manufactured flour, and meal, will be effectually expelled, so that when repacked into seasoned barrels, and stored in dry places, the grain, meal, or flour, may be kept sweet for years in the warmest climates, free from fermentation or putrefaction and the ravages of insects, and the malt dried as may be required, at the same time the germinated parts of the malted grain will be broken off by the revolutions of the cylinder, or prisms. It is not necessary that the meal or flour, should be cooled before repacking; the moisture being driven out, it cannot spoil, and may be suffered to cool in the barrels.

Now what I claim as new and as the invention of the said James Lee, deceased, for which I solicit letters patent, is, the use of the hollow, inclined cylinder, cylinders, or prisms; and strikers, in connection with a chamber, or oven, heated by means of stoves, or flues, operating in the manner and for the purposes herein set forth and described.

In testimony that the foregoing is a true specification of my late father's invention, or improvement, I have hereunto set my hand at the city of Washington, in the District of Columbia, this 3d day of August, 1835.

JAMES A. LEE, Administrator.

Specification of a patent for improvements in the process of, and apparatus for, Distilling Spirits of Turpentine and other articles. Granted to ISAIAH JENNINGS, *city of New York, August 27th* 1835.

To all whom it may concern: Be it known, that I, Isaiah Jennings, of the city of New York, in the State of New York, have invented certain improvements in the process, and also in the apparatus employed, for the dis-

tillation of Spirits of Turpentine, the spirit from common tar, coal tar, and other analogous articles; and I do hereby declare that the following is a full and exact description thereof.

My improvement in the process when turpentine is to be distilled, consists in the addition of a portion of spirits of turpentine to the crude turpentine from which the distillation is to be made; the addition being made in such proportion as shall bring the turpentine into such a state of fluidity as shall admit of the subsidence of all the foreign matter contained therein as may be sufficiently heavy to fall to the bottom, and of the rising of chips, and other light materials to the surface, whence they may be readily removed, and the clear turpentine poured off from the sediment. The quantity of spirits of turpentine to be added will depend, in part, upon the warmth of the weather, or of the place in which the mixture is made; and also upon the thickness of the turpentine to be operated upon, and the impurities which it may contain. The mixture and separation of the impurities may be promoted by artificial heat, care being taken that the temperature is not such as shall occasion a waste of the spirit by evaporation.

The apparatus which I employ consists of two vessels within each of which a still worm of the usual construction is to be contained; or instead of the worm any kind of heater, or refrigerator, by which analogous effects are produced, may be employed; these vessels are to be connected together in a way to be presently described, and one of them is to answer the purpose of a still, whilst the other is to operate as a refrigerator, or condenser. The prepared turpentine is to be contained in any convenient reservoir whence it may descend through a tube into the worm which is to operate as a distillatory, its flow being regulated by a stop cock. The vessel containing this worm is to be closed at top, and the worm is to be heated by the introduction of steam, heated air, water, or other fluid; steam, however, being preferred; a sufficient degree of heat may be thus applied to separate the spirit from the rosin as the material descends from the top to the bottom of the worm. The lower end of this worm passes through the vessel, and into a large vertical tube which is placed between it and the refrigerator or condenser. This vertical tube rises as high as the top of the condenser, and descends several inches below the point at which the first named worm enters it, having below this point a tube for the discharge of the rosin, which, not being volatile, will descend and run out by its own gravity. Its flow may be regulated by a stop cock, and may be promoted, if necessary, by the application of heat to the bottom of the tube.

The vapour of the spirit will rise towards the upper end of the tube.whence it will pass into the refrigerating worm contained in the condensing tube, down which it will pass, and be condensed in the usual way.

I intend to apply the same apparatus to the distillation of common tar, coal tar, and other analogous articles, diluting them also, with a portion of their own spirit, or with any other which will produce a like effect.

What I claim as my invention, is the preparing the turpentine for distillation by diluting it with distilled spirit, and separating, by this means, the foreign matter therefrom, thereby producing a bright clear rosin, and an improved spirit. I also claim the employment of the worm, or other analogous apparatus, to be heated in the way described, and arranged and connected in the manner, or upon the principle herein set forth, so that it may answer the purposes for which it is ordinarily employed. I also claim

the preparing and distilling of common tar, coal tar, and other analogous articles by dilution, and subsequent distillation in the same apparatus.

ISAIAH JENNINGS.

Specification of an improvement in the art of Public Finance, in loaning and actually employing credit. Granted to JOHN GOLDER, *city of Philadelphia, September* 26, 1835.

To all to whom these presents shall come, be it known that I, John Golder, of the city of Philadelphia, in the State of Pennsylvania, have invented, discovered, and formed, a new and valuable accumulative or interest bearing check or credit chart, based upon a new principle in monetary negociations, as a useful improvement in the art of finance, to be used only in the negociation of loans upon contract with actual capitalists, or in the guarantee or transfer of bona fide deposites and investments to be made; a full and exact description of which impress, and drawing thereof, as invented by me, and hereafter is to be used as aforesaid, only excepting the names, sums, vignettes, which are at all times to be written and filled up in the own proper hand writing of the person or persons concerned, conformably to the contracts made, or to be made, with the party, or parties contracting therefor, is hereunto annexed. And the inventor and author claims as his invention, not only the design and writing of the chart, or check above described, and attached hereto; according to its specific form and definite advantages of creating and sustaining credit upon its peculiar solid principle of accumulative action, and the right and privilege of using it as an improvement in the negociation of loans, and investment of capital, upon permanent visible security, but also the operative principle upon which it is based, which will admit of numerous variations in its form or manner of wording, or constructing the same, whilst the principle upon which it is intended to operate will remain substantially the same, and would therefore be necessarily considered as an evasion of my right.

JOHN GOLDER.

Each check or chart is endorsed by the Actuary, negociable on demand, in payment of instalments, or in purchase of stock.

Golder's Accumulative Patented Interest bearing Check or Chart.

MUTUAL CREDIT OFFICE CHECK, OR CHART,

PAYABLE ON DEMAND, WITH INTEREST FROM DATE.

No. *Philadelphia*

Actuary of Golder's Mutual Credit of Loan and Deposit Office, pay to the order of or bearer, dollars and cents, with interest computed at per cent., from the entry hereof, the same being negociated for, and payment guaranteed by actual deposit at the Company's office this day.

Entered day of 183

Secretary, JOHN GOLDER, [L. S.]

Industry is Gain.

Remarks by the Editor.—When wheels, levers, or pistons are in question, we feel as though we could talk familiarly and intelligibly about them; but when "Divitial inventions" and "Accumulative Checks" are upon the tapis, we are among foreigners and strangers whose language we do not under-

stand. We have never had occasion to become learned in monetary matters, being entirely destitute of the organ of pecuniary acquisitiveness. Under these circumstances we must not be looked to for any explanation of the plan before us, but as some of our readers are versed in the business of stocks and loans, it is, therefore, presented to them for their consideration.

Whether the foregoing is sustainable under a patent, does not depend upon its novelty merely, but more essentially upon the determination of the question whether the *Art of Finance*, can be classed among what are technically called "the useful arts."

Specification of a Patent for an improvement in the Mode of Turning Short Curves upon Rail-roads, with Rail-road Carriages, particularly those round the corners of streets, wharves, &c. Granted to JAMES STIMPSON, *Civil Engineer, Baltimore, Maryland, August 23d*, 1831. *Patent surrendered, and reissued on an amended specification, September 26th*, 1835.

I use, or apply, the common peripheries of the flanches of the wheels, for the aforesaid purpose, in the following manner.

I lay a flat rail, which, however, may be grooved, if preferred, at the commencement of the curvature, and in a position to be centrally under the flanches of the wheels upon the outer track of the circle, so that no other part of the wheels which run upon the outer circle of the track rails, shall touch, or bear upon, the rails, but the peripheries of the flanches, they bearing the whole weight of the load and carriage; while the opposite wheels, which run upon the inner track of the circle, are to run and bear upon their treads, in the usual way, and their flanches run freely in a groove, or channel; which treads are, ordinarily, about three inches in diameter, less than the peripheries of the flanches. Were the bearing surfaces of the wheels, which are in contact with the rails, while thus turning the curve, to be connected by straight lines from every point, there would thus be formed the frustrums of two cones, if there be four wheels and two axles to the carriage; or, if but one axle, and two wheels, then but one cone; which frustrums for the wheels representing their extremities, will, if the wheels are thirty inches in diameter, and are coupled about three feet six inches apart, turn a curve of about sixty feet radius of the inner track rail. The difference in diameter between the flanches and treads, before stated, the tracks of the usual width, and the wheels coupled, as stated, would turn a curve of a somewhat smaller radius if the axles were not confined to the carriage in a parallel position with each other; but this being generally deemed necessary, the wheels run upon lines of tangents, and those upon the inner track being as wide apart in the coupling as the outer ones, keep constantly inclining the carriage outwards, and thus cause the carriage to tend to run upon a larger circle than the difference in diameters of the treads and flanches would otherwise give; but the depth of the flanches, and the couplings, may be so varied as to turn any other radius of a circle desired.

What I claim as my invention, or improvement, is the application of the flanches of the wheels on one side of rail-road carriages, and of the treads of the wheels on the other sides, to turn curves upon railways, particularly such as turning the corners of streets, wharves, &c., in cities and elsewhere, operating upon the principles herein set forth.

JAMES STIMPSON.

Foster and Avery's Rotary Steam Engine.

We made some remarks on the subject of this engine in the last number and as it has attracted considerable attention, we have determined to publish the specification entire, in order that the nature and amount of the part claimed may be fully understood. This, with some further remarks upon it, was crowded out of the last number of the Journal, and, upon reflection, we have determined to omit the said remarks, and to give the specification alone. The original notice of this engine may be found at p. 171, vol. ix.—[Editor.

Specification of a Patent for an improvement in the Reacting Steam Engine. Granted to Ambrose Foster, *Brutus, Cayuga county,* and William Avery, *Salina, Onondaga county, New York, September 28th,* 1831.

To all whom it may concern, be it known, that we, Ambrose Foster, of Brutus, Cayuga county, and William Avery, of Salina, Onondaga county, in the state of New York, have invented a certain improvement in the steam engine, commonly called the reacting engine, and that the following is a full and exact description of our said improvement.

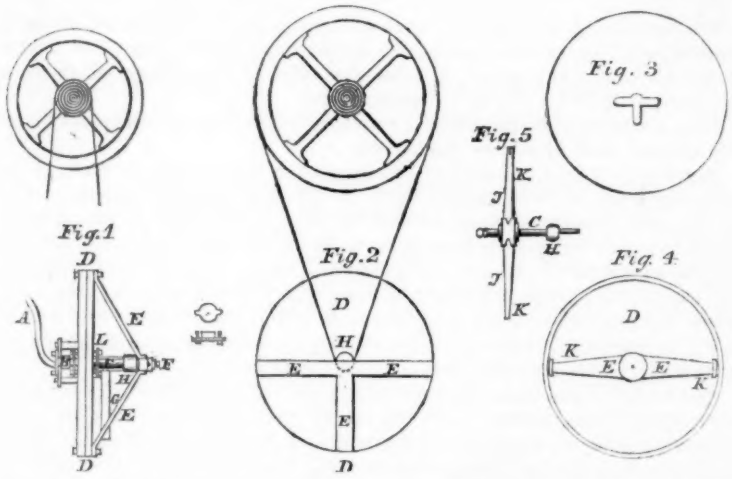


Fig. 1, in the accompanying drawing, represents a side view of the engine, the revolving arms not being visible, in consequence of their being enclosed in a circular case, to be presently described. A is a steam tube, connected with a boiler, and forming a steam-tight joint, in the box B, where it opens into the shaft C, which is made hollow to the requisite depth. D is the edge, or periphery, of a case, or drum, within which the arms from which the steam is to issue, revolve. E, E, are braces, which may be attached to the case, or drum, and at their junction support a socket, containing a centre pin, or screw, F, against which the shaft C is to run. G is a tube, through which the steam passing into the case from the revolving arms, is allowed to escape; a portion of this steam is employed to heat the water by which the boiler is to be supplied. H is a whirl upon the shaft

C, a strap from which may be employed to drive machinery. Where the same parts occur in the other figures in the drawing, they are represented by the same letters.

Fig. 2, shows the flat side of the drum, or case; the arms, or braces, E, E; the whirl, H, and the manner in which straps, or other gearing, may be carried from one wheel to another. Fig. 3, is the opposite side of the drum, or case.

E, E, in Fig. 4, shows the flat sides of the revolving hollow arms; and J, J, Fig. 5, is an edge view of the same. In Fig. 4, one side of the case is supposed to be removed, and, in Fig. 5, the whole case. At K, K, openings are made in the narrow edges of the arms, in directions opposite to each other, to allow of the escape of the steam introduced into them through the shaft C, with the hollow of which they communicate.

In an engine which we have in actual operation, the arms, E, E, (or J, J,) are each twenty inches in length. The width of the arms at the centre is about six inches, and at the ends about two and a half inches; in depth, or thickness, they are about one and a half inches near the centre, and about three-fourths of an inch near the end. The size of the holes through which the steam escapes, is about one-quarter, by one-eighth, of an inch. The holes are so perforated that the steam shall issue at right angles with the shaft.

We have found this engine to act with great power, but do not intend to confine ourselves to these particular proportions, as we mean not only to vary the size of our engines, but also the relative proportions of their respective parts, according to circumstances.

L, L, are parts of stuffing boxes, employed to prevent the escape of steam, in a manner well known to machinists.

We find it to be a point of great importance to give such a form to the revolving arms, as shall subject them to the least possible resistance from the air; we, therefore, instead of making them in the form of round tubes, which has been heretofore done, give to them the form which results from making each half of the arm a segment of a large circle, so that, when the two halves are united, the edges of the tube present acute angles. The tubes, however, may be made elliptical, or oval, and the same end will be, in a great measure, attained. We use any number of such arms on the same shaft, as we may find best adapted to our purpose.

We do not claim to be the inventors of the reacting steam engine, nor of the case, or drum, within which we intend the arms shall, in general, revolve; but what we claim as our invention, is, simply, the giving the oblate, or flat, form to the revolving arms, so that, in proportion to their capacity, they shall experience much less resistance from the air than that to which they have been heretofore subjected, thereby obtaining a greatly increased power.

AMBROSE FOSTER,
WILLIAM AVERY.

Progress of Theoretical and Practical Mechanics.

Lever and Spring Balances. By CHARLES T. COATHUPE.

The public are already indebted to the ingenuity of many for various contrivances adapted to the purpose of weighing. Some have vastly improved

the convenience of the old-fashioned beam. Others have devoted their attention to supersede the employment of weights, by the use of oval or spiral springs, and have produced very effective and perfect instruments, with all the accuracy necessary for their intention, such as Marriott's Dial, and Salter's Spring Balance. But no person has yet availed himself of the effects which are to be derived from the union of the two principles already adopted. It is, then, with all due deference to the better judgment of others, that I propose a machine of very easy manufacture, and small expense, by combining the lever with the spring balances of Marriott, or Salter, which appears to offer many advantages over either used alone.

Fig. 1 represents the arrangement for heavy weights, where we will suppose the distance from the fulcrum to the point of suspension to which the spring balance is attached, to be eight times the distance of the fulcrum from the point to which the weight is to be suspended. Salter's balances, graduated to weigh 24 lbs., and whose cost is about five shillings, will then weigh 192 lbs., and each $\frac{1}{4}$ lb. division will indicate 2 lbs.

Fig. 1.

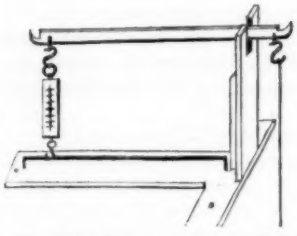


Fig. 2.

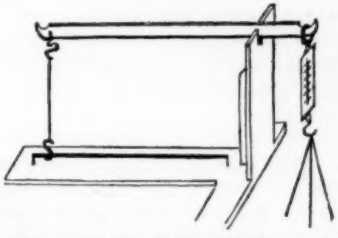
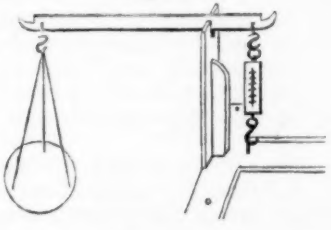


Fig. 2 is the reverse application, and may be used for light weights. Of course, each $\frac{1}{4}$ lb. division will then represent only $\frac{1}{4}$ oz.

Fig. 3 is merely the conversion of the lever to a simple hook for supporting the spring balance, when used in the ordinary manner for immediate purposes.

Fig. 3.



It is obvious that, with a combination of this kind, and using one of Marriott's dials, calculated to weigh 2 cwt., we may readily make it available for weighing a ton, and thus have not only the perfect use of the dial itself, when detached, but a machine capable of weighing very heavy packages without weights, thereby avoiding the expense of such weights, the trouble of removing them, and the risk of a false computation.—[*Lond. Mech. Mag.*

Effect of the velocity of Air upon its use in Smelting Iron.—M. Teploff, one of the Russian Mining Corps, in an article on the improvements recently introduced into the smelting of iron in Russia, makes the following statement. In the smelting furnaces of the Ural, where the quantity and velocity of the blast are properly regulated, 1.4 of pig iron is obtained by 1 of charcoal fuel, while in other furnaces they obtain but .4 and .6 by the same consumption of fuel.

The velocity of the blast being increased, the heat within is increased, without a corresponding consumption of fuel. In an experiment made by order of the government, it was found that one hundred cubic feet of air, under a pressure of two inches of mercury, produced the same effect as two hundred cubic feet, under a pressure of one inch, with this difference, that, in the latter case, twice the fuel was consumed, which was required in the former case.

In one furnace which is mentioned, 22,000 lbs. of iron were obtained in twenty-four hours, by 16,000 lbs. of charcoal. Previous to the due regulation of the draught, they consumed twice this amount of fuel for the same yield of iron.

This economy is obtained by duly proportioning to each other the size of the blast pipe, and the pressure of the draught. The relation of these to each other, varies with the furnace.

M. Teploff asserts that the results thus obtained exceed those with the hot air blast, but it does not appear that any comparisons have been made under his examination, and with the charcoal fuel.

To regulate the draught, it is recommended to place two mercury or water gauges, one near the blast pipe, the other near the governor of the blowing machine. By varying the pressure, and the diameter of the nozzle of the blast pipe, making the latter smaller as the former is increased, and vice versa, the best proportion is to be ascertained.—[*Annales des Mines, vol.* vii.

Preservation of Wood from Dry Rot.—It is stated as the result of observations made in the German mines, that pine wood, which has been exposed to the action of water under pressure, is not subject to the dry rot. A stick of pine wood, placed in water in an iron pipe, absorbed, in thirty-six days, 27 per cent. of water. Subsequent exposure for thirteen days, in a warm room, evaporated $15\frac{1}{2}$ parts of the water.

A similar stick of wood, exposed for the same time, but pressed, at intervals, by a force of nearly fifty atmospheres, absorbed 118 per cent. of water. Of this, when the wood was exposed as above stated for the other piece of timber, there evaporated 21 parts.

The wood was not sensibly increased in bulk by the absorption of the water. The bulk of water absorbed in the second experiment having been nearly one-thirty-ninth that of the wood.—[*Ibid.*

Proportion of Ashes in different parts of Wood.—A portion of heart wood, of sap wood, and of intermediate layers, of the trunk of an oak of sixty years of age, which had grown in a sandy loam, were separately burned. The heart yielded .27 per cent. of ashes, the middle layers .34 per cent., and the sap wood .532 per cent.—[*Journ. of Pract. Chem.* (*Germ.*) *Ann. des Mines, vol.* vii.

Progress of Physical Science.

Experimental researches in Electricity. Eighth Series. By Michael Faraday, *&c. &c. Phil. Trans. Lond.* 1835.*

1. Metallic contact is not necessary to the production of the voltaic current. Decomposition of iodide of potassium is obtained by zinc and platinum

* Abstract made for this Journal.—[Com. Pub.]

plates, immersed in part in a diluted acid, and separated above the acid solution by a piece of paper moistened with the iodide. The iodine appears at the platinum wire terminating the platinum plate.

2. Metallic contact is effective by opening a path for the voltaic current without introducing any new affinities to oppose that of the exciting fluid. Such an opposition would occur, if compounds capable of being decomposed by the current, were used to connect one set of extremities of the plates, while the other extremities were dipped into a dilute acid.

3. A simple galvanic circle is capable of effecting chemical decompositions when the elements of compounds are united by a weak affinity, or by proportioning the affinities producing to the current to those of the compounds to be acted upon.

The following compounds are placed in the order of facility of decomposition, the first requiring the lowest intensity of current.

Iodide of potassium (solution). Chloride of silver (fused). Protochloride of tin (fused). Chloride of lead (fused). Iodide of lead (fused). Muriatic acid (solution). Water acidulated with sulphuric acid.

4. "The electricity of the voltaic pile is not dependent either in its origin or its continuance on the contact of the metals with each other. It is essentially due to chemical action, and is proportionate in its intensity to the intensity of the affinities concerned in its production; and in its quantity to the quantity of matter which has been chemically active during its evolution."

5. "Volta-electric decomposition is simply a case of the preponderance of one set of chemical affinities more powerful in their nature over another set which are less powerful; and if the instance of two opposing sets of such forces be considered, and their mutual relation and dependence borne in mind, there appears no necessity for using, in respect to such cases, any other term than chemical affinity (though that of electricity may be very convenient,) or supposing any new agent to be concerned in producing the results; for we may consider that the powers at the two places of action are in direct communication, and balanced against each other through the medium of the metals, in a manner analogous to that in which mechanical forces are balanced against each other by the intervention of the lever."

6. "All the facts show us that the power commonly called chemical affinity can be communicated to a distance through the metals and certain forms of carbon; that the electric current is only another form of the forces of chemical affinity; that its power is in proportion to the chemical affinities producing it; that when it is deficient in force it may be helped by calling in chemical aid, the want in the former being made up by an equivalent of the latter; that in other words, the force termed chemical affinity and electricity are one and the same."

7. Chemical action is not of itself sufficient to produce an electrical current, the substance acting chemically must be in combination, and in such a state of combination as to be capable of decomposition by electricity. Thus liquid chlorine will dissolve the zinc of a voltaic battery, but no electrical current will result. It is not sufficient that a body act chemically, and be a conductor of electricity, it must be decomposable. Thus, metallic tin acting on platinum plates evolves no electricity.

It follows from this, that the sulphuric acid used in the battery evolves no electricity in combining with the oxide of zinc. It merely dissolves the oxide, exposing a fresh surface to oxidation.

8. Notwithstanding the extraordinary state which must be assumed by an

electrolyte either during decomposition, when an enormous quantity of electricity must be traversing it, or in the state of tension which is assumed as preceding decomposition, still it has no power of affecting a ray of polarized light, and hence no peculiar structure is to be inferred in this way.

9. The state of tension just referred to may be rendered evident by immersing in dilute sulphuric acid a single pair of galvanic cylinders, provided with cups to contain mercury, making an electrical communication for the plates by means of an amalgamated wire. On dipping one end of the wire into one of the mercury cups, and bringing the other end *near* the other cup, a spark passes through the intervening air.

10. Mr. Faraday next examines fully by experiment the following questions. Can electrolytes (bodies capable of decomposition by electrical currents) resist an electrical current below a certain intensity? Is the intensity at which the current ceases to act the same for all bodies? Will electrolytes thus resisting decomposition conduct electricity or serve as insulators?

(*a.*) A current excited by the action of dilute sulphuric acid on a pair of zinc or platinum plates was capable of decomposing iodide of potassium, but not water. The current evolved with the same plates, when nitric acid was added, decomposed water. A current which decomposes a solution of iodide of potassium may not be able to decompose one of sulphate of soda, the current being conducted in each of these cases.

(*b.*) In similar experiments fused chloride of silver was decomposed by a current which was conducted, without decomposition, by fused chloride of lead, and by fused nitre.

(*c.*) Water, whether pure or acidulated, seems to be equally decomposable by an electrical current, and has the same conducting power, whether pure or acidulated, for currents unable to decompose it.

11. A curious conclusion from the view of a certain electrical intensity being necessary to the decomposition of bodies is, that "we may arrange circumstances so that the *same quantity* of electricity may pass in the *same time*, in at the *same surface*, into the *same decomposing body*, *in the same state*, and yet differ in intensity, *decomposing in one case and not in the other*. For taking a source of too low an intensity to decompose, and ascertaining the quantity passed in a given time, it is easy to take another source having a sufficient intensity, and reducing the quantity of electricity from it by the intervention of bad conductors to the same proportion as the former current, and then all the conditions will be fulfilled to produce the result described.

12. In considering the effects of many alternations of simple galvanic circles, giving rise to the battery, Mr. Faraday gives the following view of the increase of intensity with the number of pairs of plates, while the quantity remains the same. "The electricity which passes across the acid from the zinc to the platinum in the first cell, and which has been associated with, or even originated by, the decomposition of a definite portion of water in that cell, cannot pass from the zinc to the platinum in the second cell without the decomposition of the same quantity of water there, and the oxidation of the same quantity of zinc by it." The quantity of electrolyte decomposed, and of electricity passed, must, as has been before shown, be the equivalents of each other. "The action in each cell, therefore, is not to increase the quantity set in motion in any one cell, but to aid in urging forward that quantity, the passing of which is consistent with the oxidation of its own zinc; and in this way it excites that peculiar property of the current which we endeavour to express by the term *intensity*, without increas-

ing the *quantity* beyond that which is proportionate to the quantity of zinc oxidized in any single cell of the series."

(*a.*) In proof of this position, ten pairs of amalgamated zinc and platinum plates were arranged with dilute sulphuric acid, forming a battery. When the circuit was completed, hydrogen was given off in each cell, and being collected, proved the same for each cell of the battery and chemically equivalent to the zinc dissolved.

(*b.*) This fact has been proved "long ago, in another way, by the action of the evolved current on a magnetic needle; the deflecting power of one pair of plates in a battery, being equal to the deflecting power of the whole, provided the wires used be sufficiently large to carry the current of the single pair freely; but the *cause* of this equality of action could not be understood whilst the definite action and evolution of electricity remained unknown."

(*c.*) "Whatever *intensity* may be," "there seems to be no difficulty in comprehending that the *degree* of intensity at which a current is evolved by a first voltaic element, shall be increased when that current is subjected to the action of a second voltaic element, acting in conformity and possessing equal powers with the first." Since the act of decomposition opposes a certain force to the electric current, and one which is of the same kind with this force, it is obvious that bodies may resist a current of one intensity, and give way to a more powerful one. Nor does this contradict the law of definite electrical action.

(TO BE CONTINUED.)

Tellurium, and its Compounds with Oxygen.—Pure tellurium may, according to Berzelius, be procured by mixing the ore with carbonate of potassa, or of soda and oil. The mixture is exposed to heat in a crucible. When the oil has been decomposed, the heat should be raised for a short time nearly to whiteness. Water passed through the substance remaining in the crucible dissolves the telluret of potassium. This liquid must be kept during the washing from air, if all the tellurium is to be extracted. The telluret of potassium exposed to the air deposits tellurium, the potassium oxidating. By distillation the metal is purified. To effect its conversion into vapour, the highest heat of a small wind furnace, aided by a stream of hydrogen gas, is necessary.

With proper precautions sulphurous acid may be used to precipitate tellurium from its solution in muriatic acid. The metal appears in flakes, and not as a black powder, as when obtained by the process above described.

Tellurium is brittle and crystalline. Its specific gravity is about 6.2. It vapourizes at a temperature at which white glass is too soft to confine the vapour. The odour of volatilized tellurium is different from either sulphur or selenium, to which bodies it is allied in its general character. The equivalent is nearly 8.02.

The substance commonly considered as oxide of tellurium, formed by the action of nitric acid on tellurium, Berzelius finds to be an acid for which he proposes the name tellurous acid. Of this acid he describes two varieties. One of them contains water, the other is anhydrous. They contain two equivalents of oxygen united with one of the metal.

Telluric acid is obtained by oxidating tellurous acid by nitre, or by acting upon tellurite of potassa by chlorine. Decomposing the tellurate thus formed by chloride of barium, and in turn decomposing the insoluble tellurate of baryta by sulphuric acid. This acid contains three equivalents of oxygen. The crystalized acid contains three equivalents of water.

The two acids just referred to are similar in composition to sulphurous and sulphuric acids. Berzelius was not successful in his attempts to procure hypo-telluric acid, nor in those to obtain a lower degree of oxidation than tellurous acid.—*Ann. de Chim. et de Phys.*

Oxygen in Air contained in Snow.—M. Boussingault found in snow water, collected in his descent from Chimborazo, but 16 per cent. of oxygen.—*Ibid.*

Flint and Chalcedony not Simple Minerals.—Professor Fuchs, of Munich, finds that opal, which is amorphous silica, dissolves in caustic potash even when in mass, and that in powder it is rapidly taken up. Powdered opal unites with lime in the moist way, and the mass hardens under water.—*Ibid.*

Flint is a mixture of quartz and opal, and the latter may be separated from fragments of flint by potash. Chalcedony contains more of it than flint.—*Jameson's Journal.*

Temperature of the Earth, as shown by that of the Waters of Artesian Wells.—M. Arago states as the result of observations not published, that the temperature of the water from these wells increases with the depth of the source, at the rate of one degree Fah. for every thirty-seven to fifty-four feet.—*Jameson's Journal.*

Quantity of Rain at Different Elevations.—The register of the rain fallen at Kinfauns Castle, for the year ending in December, 1834, gives 23.10 inches by a rain gauge in the garden, 20 feet above the level of the sea, 23.25 by a gauge in the Castle tower, 180 feet above the same level. The *greater* quantity at the *upper* level.

Mechanics' Register.

Berlin Iron Ornaments.—Some of these are so fine, consisting of rosettes, medallions, &c., that nearly ten thousand go to the pound. In the coarse fabrics the value of the material is increased by manufacturing eleven hundred times, and in the finer nearly ten thousand times.—*Arcana of Science*, 1835.

Mortality in Europe.—It appears from tables of mortality in the principal states of Europe that there dies annually 1 inhabitant out of 28 in the Roman States, and the ancient Venetian provinces; 1 in 30 in Italy in general, Greece and Turkey; 1 in 39 in Netherlands, France and Prussia; 1 in 40 in Switzerland, the Austrian Empire, Portugal and Spain; 1 in 44 in Russia in Europe and Poland; 1 in 45 in Germany, Denmark, and Sweden; 1 in 48 in Norway; 1 in 53 in Ireland; 1 in 58 in England, and 1 in 59 in Scotland and Iceland.

The Quadrant.—In 1734 it was said, "as soon as the common prejudice against new things is worn off, and the instrument is well known, I do not believe any ship will go on a long voyage without one of these excellent quadrants."

A French Mechanic.—M. Cavi was brought up a joiner. After serving in the army (what Frenchman is not a soldier?) he returned to Paris with a capital of 50 *cents*. He worked with a pattern maker during the day and in the evening took lessons in drawing; and as much of the night as could be spared from sleep worked upon the plans commenced in the drawing school. In 1823, he undertook the manufacture, in a small way, of steam engines, and in eight years had become possessed of stock in trade to the amount of one

thousand dollars. After losing two-fifths of this by the failure of an individual connected in the way of business with him, he succeeded in recovering himself so far that in ten years he had manufactured 123 steam engines, the total nominal power being 2,835 horses. He has made recently an iron steamboat, navigating the lakes Neuchatel, Thorum, &c. His present establishment enables him to furnish a steam engine of 160 horse power in a month.—*Baron Dupin.*

Curious fact in relation to the Hedge-Hog.—It is stated on the authority of M. Lenz and Prof. Buckland, that the most virulent animal poisons have no effect on the hedge-hog, and further on the authority of a German physician that prussic acid, arsenic, opium, and corrosive sublimate were given to an animal of the species, without injurious effect.—*Arcana of Science*, 1835.

List of American Patents which issued in January, 1836.

		January
1.	*Water-proof silk hats.*—George B. Dexter, Boston, Mass.	6
2.	*Belt saw for timber.*—Benjamin Barker, Ellsworth, Maine,	6
3.	*Saw for felling trees.*—Walter Hunt, New York,	6
4.	*Cleaning clover seed.*—James Manning, Lambertsville, New Jersey,	6
5.	*Washing machine.*—Joab H. Hubbard, Bloomfield, Conn.	6
6.	*Cutting wooden screws.*—Joseph Peavy, Levant, Maine,	6
7.	*Dying hats.*—Aaron Gould, Washington, Conn.	11
8.	*Lock for doors.*—Solomon Andrews, Perth Amboy, N. J.	11
9.	*Cutting grain, &c., mill for.*—William Gerrish, Portsmouth, N. H.	11
10.	*Wharves, piers, &c.*—John G. Pray, Brooklyn, N. Y.	11
11.	*Napping machine.*—Stephen Marsh, Jericho, Vermont,	11
12.	*Drills for metal*, &c.—William R. Jones, Granville, N. Y.	11
13.	*Hanging wagons, &c.*—Henry Mellish, Walpole, N. H.	11
14.	*Planting corn.*—Charles R. Belt, Washington city,	15
15.	*Plough.*—John Dalkaner, Canton, Ohio,	15
16.	*Bedsteads.*—Jonas Maguire, Philadelphia,	15
17.	*Hydraulic cement.*—Levi Kidder, New York,	15
18.	*Wells, &c., covers of.*—Levi Kidder, New York,	15
19.	*Packing tobacco.*—J. B. Allen, Richmond, Va.	15
20.	*Ropes, &c., making.*—John Whiteman, Philadelphia,	15
21.	*Trunks, valises*, &c.—James W. Noble, Pittsfield, Mass.	15
22.	*Plough.*—Samuel Witherow, Gettysburg, Pa.	15
23.	*Stove, air-tight.*—Isaac Orr, Washington city,	20
24.	*Baker, reflecting.*—L. B. Olmsted, Binghampton, N. Y.	20
25.	*Grooves in corset rings, &c.*—Charles Buckland, Middletown, Conn.	20
26.	*Thrashing machine.*—Ebenezer Brown, Chenango, New York,	20
27.	*Horse power.*—Samuel Newton, Dayton, Ohio,	20
28.	*Propelling boats.*—Philander Noble, Westfield, Mass.	20
29.	*Plough.*—J. P. Chandler, and P. Ranger, Milton, Maine,	20
30.	*Saddles and collars.*—Ebenezer Hale, New York,	23
31.	*Hulling corn.*—Warren Carpenter, New Castle, Pa.	23
32.	*Force pump.*—Benjamin Egbert, Lansing, N. Y.	23
33.	*Stove-pipes.*—Ezra Ripley, Albany, New York,	23
34.	*Sulkey seat.*—O. H. Capron, and G. Barton, Jr., Shaftsbury, Vermont,	23
35.	*Packing flour.*—J. F. Barrett, Granville, N. Y.	23
36.	*Wooden bridges.*—Stephen H. Long, Topographical Engineer, U. S.	23
37.	*Hoes.*—Adna Allen, Ramapo, New York,	23
38.	*Trap for rats, &c.*—Thomas Neill, Herkersville, Ohio,	23
39.	*Hydraulic cement.*—John White, Syracuse, N. Y.	23
40.	*Horse collar.*—John Hopkinson, Warren county, Ohio,	23

CELESTIAL PHENOMENA, FOR MAY, 1836.

Calculated by S. C. Walker.

Day.	H'r.	Min.	Sec.				
5	13	15		Im. a Sagittarii,	,5,6,	N. 140°	V. 102°
5	14	10		Em.		225	194
14	19	3	21	*Im. sun by moon,		320	265
14	20	13	26	N. App. centres,		212	158
14	21	32	33	Em. sun by moon,		104	55
20	8	44		Im. λ Cancri,	,6,	67	124
20	9	47		Em.		253	308
30	11	47		Im. A Ophinchi,	,4,5,	52	45
30	12	57		Em.		278	284

* For irradiation, 5″, and 12.1s. to time of beginning.
† " " subtract 15.1 from time of end.

Meteorological Observations for January, 1836.

Days.	Moon.	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches.	Inches.			Inches.	
1	☉	17°	36°	29.90	29.90	W.	Moderate.		Clear day.
2		28	47	.93	30.01	SW.	Calm.		Clear day.
3		35	35	30.15	.30	E.	do.		Drizzle—cloudy.
4		32	37	.2	.05	E.	Moderate.		Rainy day.
5		37	36	29.98	29.90	E.	do.		Drizzle.
6		31	31	30.13	30 24	E.	do.		Drizzle—cloudy.
7		26	32	.14	.00	NE.	Brisk.		Cloudy—light snow.
8		33	33	29.66	29.60	E.	Blustering		Rain.
9		32	32	.50	.50	NE.	do.	2.90	Snow, 2 feet, drifted.
10		27	30	.34	.34	W.	do.		Snow—cloudy.
11		29	32	.54	.56	W.	Moderate.		Snow—clear.
12		30	35	.75	.70	W.	do.		Clear day.
13	☽	32	49	.96	.94	W.	do.		Clear—cloudy.
14		33	49	30.00	30.00	W.	do.		Clear day.
15		32	32	30.05	.05	W.	do.		Clear day.
16		25	23	.15	.20	NW.	do.		Clear—lightly cloudy.
17		11	27	29.90	29.70	NE.	do.		Snow—sleet.
18		24	32	.50	.50	W.	do.		Sleet—cloudy.
19		31	42	.55	.55	W.	do.		Clear—lightly cloudy.
20	⊗	11	45	30.10	.15	W.	do.		Clear day.
21		10	34	.20	.15	SE.	do.		Cloudy—lightly cloudy.
22		36	40	29.70	29.70	W.	do.		Rain—lightly cloudy.
23		16	21	30.00	30 10	NW.	do.		Clear day.
24		9	36	.40	.45	NW.	do.		Partially cloudy—sleet, with snow
25		35	36	29.53	29.60	SW.	Blustering.		Snow—clear.
26		17	31	.94	.90	W.	Moderate.		Cloudy—lightly cloudy.
27		1	20	.98	.96	W.	do.		Clear day.
28		7	11	30.00	30.03	W.	do.		Clear day
29		3	23	.00	.03	W.	do.		Clear day.
30		17	32	29.90	29 90	WSW.	do.		Lightly cloudy.
31		34	32	.60	.54	SSW.	do.		Snow.
Mean		24.6°	31.39	29.90	29.90				

Thermometer.		Barometer.
Maximum height during the month,	49. on 14th.	30.45 on 24th.
Minimum do.	1. on 8th.	29.34 on 10th.
Mean do.	29.90	

In consequence of an accident which happened to the rain gauge, no estimate could be made of the quantity fallen since the 8th of January.